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EVERYDAY ARITHMETIC

Revised Edition

INTERMEDIATE BOOK

BY

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FOREWORD

THIS book, which is intended for use in the fifth and sixth years of school, has for its chief tasks the development of skill in the fundamental processes and a knowledge of common and decimal fractions with their applications to useful problems.

The aim of the work is practical; the plan followed is in accord with recent educational thought. Each new arithmetical topic is taught in relation to its everyday use. Each main subject is treated informally before rules and definitions are given. The emphasis is laid on common business fractions, on decimals of two and three places, and upon problems that are met with in life. No long unpsychological explanations are required of the pupils. No unusual processes are taught.

To bring the work close to the interests of the pupils, the problems have not only been taken directly from experience, but they have been grouped under large topics of vital interest to boys and girls. The authors believe that a mistake has been made in expecting pupils to jump rapidly from one situation to another of different character, involving difficulties in interpreting the language and in picturing the conditions, as well as in selecting the right number-processes. In life, we are usually confronted not by sets of miscellaneous problems, but by series of questions arising out of a single situation. This new grouping, it is believed, will prevent the scattering of the pupils' attention and lead to cumulative intelligence in handling problems.

Following the plan of the other books in the series, this book makes provision for the varying abilities of children. For the stronger pupils, the book provides difficult problems starred as optional work. For pupils who fall below the average of the class,

there is supplementary practice so that, by extra effort, these pupils may reach the required standard.

Besides taking into account the differences in ability of pupils, the authors have kept in mind the special needs of the unfortunately large numbers of boys and girls who are obliged to leave school at the end of the sixth grade. To equip these children for their work in life, this book not only covers the essential processes, but gives groups of problems in wage-earning, in the economical use of money, and in many other of the ordinary transactions of everyday life.

BRIEF SUGGESTIONS TO TEACHERS

Arouse the ambition of the pupils by teaching each new topic and reviewing each old one in connection with some practical application, so that the pupils see the advantage in mastering the work.

Follow the plan of the book by laying a careful foundation for each main topic of the year's work: (1) give many simple concrete problems in fractions before teaching any rules; (2) review United States money before taking up decimals; (3) see that pupils understand problems in comparison and on "the whole and the part" before giving work in percentages. (See pages 30–39; 90–96; 209–213.)

Teach new topics from the blackboard and then use the books to fix the new work in the minds of the pupils.

Explain processes carefully, but do not expect pupils to repeat your explanations. The pupils should be made intelligent in the use of number, but it should be remembered that the chief aim of the work of the fifth and sixth grades is not so much an understanding of principles as a thorough mastery of processes.

In all drill work lay the emphasis on fractions of small denominations, decimals of one, two, and three figures, and the more common per cents.

Train pupils to work rapidly, but at the same time carefully.

See that pupils write figures and arrange work neatly.

See that they acquire independence of the pencil in their work.

Hold pupils to a high standard of accuracy. For those pupils who are below the standard required, set aside for systematic practice one or two five-minute periods a day. (See tests and practice throughout the text.) A careful record should be kept of the results of all tests so that each pupil may be given the work most needed by him individually.

In all problem work, lay the emphasis on oral rather than on written work.

See that all problems have meaning to pupils.

Vary the difficulty of the problem work so that pupils do not meet too many difficulties at one time. For example, the pupils should be led to solve two- and three-step problems in their work with integers and United States money, but in the addition of unlike fractions where the process used is involved, the problems should be kept simple.

In helping pupils to understand the solution of problems, give them much practice (*a*) in solving problems without the use of a pencil, (*b*) in finding approximate answers, (*c*) in giving orally the steps in the solution of problems without doing the work, and (*d*) in writing answers to test problems. (See footnotes, pages 25 and 88.)

Encourage pupils to work independently. Let them discover original methods of solving problems. Have them bring in local data and state and solve problems of their own.

In getting the standing of pupils for reports and promotions, the tests in the book may be varied by changing the numbers slightly. Also, in ranking pupils, the starred problems should be taken into consideration. Those pupils who are able to do such optional work should receive due credit for this work.

PART THREE

CHAPTER I. EVERYDAY BUSINESS PROBLEMS

1. Making Change

[Without pencil.]

1. What coins are commonly used in buying goods? Name them in the order of their value.

2. The coins given for a baseball were a silver half-dollar and a silver quarter. What was the price paid?

3. A pocket book contains a dollar bill, a half-dollar, a quarter, 2 dimes, and a five-cent piece. How much money does it contain?

4. In buying a box of candy, Margaret gave the clerk a dollar bill and received as change a half-dollar and two dimes. How much did the box of candy cost?

Find the value:

5. Of 1 quarter, 1 dime, and 3 nickels.

6. Of 1 half-dollar and 3 dimes.

7. Of 3 quarters, 1 dime, and 8 cents.

8. Of 1 half-dollar, 1 quarter, 1 dime, and 1 nickel.

9. Which would you rather have, 3 dimes and a nickel or 2 quarters? 6 quarters or 3 half-dollars?

10. How many nickels does it take to make 50¢?

11. How many dimes can you get for $1.00? For $1.50?

12. A two-dollar bill is changed for quarters. How many quarters should be received?

13. What two silver coins equal 50¢? What four equal $2.00?

14. I buy a book for 35¢ and give the clerk a half-dollar. What coins might I receive as change?

Name one set of coins that might be received as change:

15. From a quarter in buying a pencil for 5¢.

16. From a half-dollar in buying a notebook for 15¢.

17. From a dollar in buying a knife for 45¢.

18. From a two-dollar bill in buying a book for $1.25.

19. From a dollar bill in buying a box of paints for 25¢ and a paint brush for 15¢.

20. A boy buys a notebook for 15¢ and hands the clerk a half-dollar. The clerk gives him as change a dime and a quarter. Tell how he might count out the change.

Use real coins, if possible, and count out change:

21. From a half-dollar for a box of paper bought for 20¢.

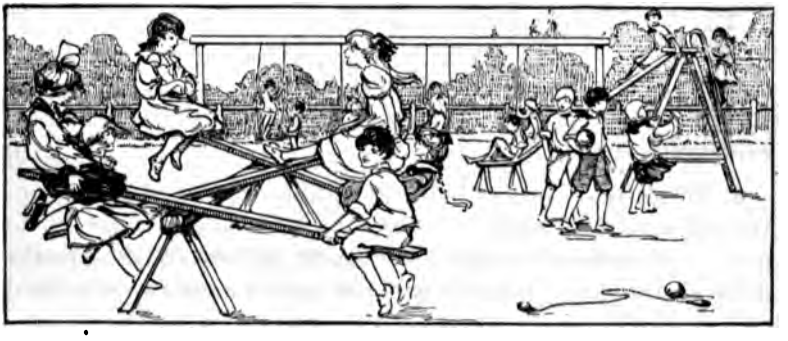
22. From a dollar bill for a pencil box bought for 35¢.

23. From a two-dollar bill for a fountain pen bought for $1.25.

24. From a ten-dollar bill for a camera bought for $4.25 and 2 rolls of films bought for 30¢ a roll.

25. Imagine that other purchases are made. Practice counting out the change for them.

2. Fitting out a Playground



(1) A volley ball and a net are to be bought for a playground. How much must be paid for them if $5.75 is charged for the ball and $2.50 for the net?

(2) In paying for the ball and net, how much change should be received from a ten-dollar bill?

(1)

The amount to be paid for the ball and net is the sum of $5.75 and $2.50.

$5.75 + $2.50 = ?

$5.75
2.50
$8.25 Sum

Am't to be paid for the ball and net = $8.25.

(2)

The change that should be received is the difference between $10.00 and $8.25.

$10.00 – $8.25 = ?

$10.00 Minuend
8.25 Subtrahend
$1.75 Difference or Remainder

Am't of change = $1.75.

Test: $1.75 + $8.25 = $10.00.

[Without pencil.]

1. Why, in solving the first problem about the playground (page 3), was it necessary to add?

2. What name is given to an answer found by addition?

3. In solving the second problem, why was it necessary to subtract?

4. What terms are used in subtraction? Which number is the minuend? Which is the subtrahend? Which is the difference or remainder?

5. An answer found by addition is usually tested by adding each column in the opposite direction. How is an answer found by subtraction tested?

6. Notice that, since only like quantities can be added or subtracted, care was taken in both problem (1) and problem (2) to place cents under cents and dollars under dollars. Where was the dollar sign written? How many places in each answer were pointed off for cents?

[With pencil.]

7. The children in a certain school fitted out their playground. First, in order to earn money, they gave a concert and a play and had a candy sale. At the concert they cleared $26.75; at the play, $48.20; at the candy sale, $32.40. How much money altogether did the children earn?

8. For the youngest children, sand boxes were bought for $6.25, a load of beach sand for $3.50, and a large rubber ball for $2.25. Find the cost.

9. In paying for the load of sand, how much change should have been received from a five-dollar bill?

10. For the children next in age, swings were put up for $29.90, and seesaws for $36.75. For the eldest children, a football was bought for $4.25, a basket ball for $4.00, and a volley ball with a net for $8.25. How much was paid for these things?

11. Find the total cost of all the articles bought for the playground. (See problems 8 and 10.)

*12. Find how much the children had left of the money earned at the three entertainments, after paying for the articles named in problems 8 and 10.[1]

*13. The children wished to buy also a slide costing $65.00. How much more money did they need in order to pay for it?

3. Practice in Addition and Subtraction

These exercises are to help you find out and overcome your difficulties in adding and subtracting. Write answers on the folds of a sheet of paper placed below the problems in the book.[2] Work rapidly but at the same time carefully.[3]

I. Review of Fundamental Facts

Test No. 1. Addition. Practice on each of these exercises until you can write the correct sums for each set of 11 problems in 30 seconds. Add with only a few words in mind. In adding 4, 5, 7, think *9*, *16*, or merely *16*.

[Write answers only.]

Add:

1.	7	3	4	4	4	9	6	8	6	8	8
	5	4	2	4	5	2	4	4	4	2	1
	4	4	3	5	3	2	5	2	3	6	3
2.	8	5	5	7	9	7	8	9	8	7	9
	0	4	7	0	5	1	2	7	0	3	6
	7	2	2	4	2	4	5	0	5	4	3

[1] All problems starred are intended as optional work. See Preface.

[2] Have each pupil fold his sheet of paper back about one inch for each row of answers; or, have pupil first flute his paper, as in making a paper fan, and then write a row of answers on each fold.

[3] For those pupils who are below the standards given, it will be found helpful to provide for practice one or two five-minute periods a day. As soon as a pupil passes a test it should be checked off on the teacher's record.

3. 5	5	9	8	6	9	7	9	9	8	9
1	6	3	1	3	7	3	0	8	3	2
7	2	0	7	5	1	3	5	0	6	4

Test No. 2. Subtraction. Practice on each set of nine problems until you can write the correct answers in 20 seconds. Think differences only. In taking 9 from 17, think *8*, not *9 from 17 is 8*.

1. 11	11	11	11	13	14	14	14	15
7	5	6	4	5	8	6	9	7
2. 12	12	13	13	12	15	15	15	16
7	5	7	5	4	6	9	8	7
3. 13	13	13	14	8	17	16	18	17
6	8	9	5	0	8	9	9	9

II. Accuracy in Longer Problems

If, within the time limit, you fail to get the correct answers to all of the problems in a test, practice solving the problems in the set having the same number, then try the test again.

[With pencil.]

Test No. 3. Add. Time limit, 60 seconds.

7	6	9
4	4	4
4	5	3
8	7	6
6	6	6
2	4	5
5	2	8
8	8	8
7	5	9

Practice No. 3. Practice adding at a steady rate.

1. 2	4	5	2. 2	5	3
5	5	6	6	5	5
8	7	7	9	6	9
6	4	3	8	7	9
7	8	8	7	7	7
4	6	8	3	5	2
4	5	3	6	8	7
7	7	7	9	9	9
5	6	9	4	3	5

3.	6	3	7	4.	3	4	5	5.	4	5	3
	4	5	3		6	9	7		7	0	4
	5	2	2		5	7	6		4	7	8
	7	5	8		8	0	4		0	3	4
	2	8	6		7	6	4		3	5	7
	4	6	3		2	5	7		2	9	7
	8	5	7		9	5	4		3	4	6
	9	7	5		7	7	9		8	8	5
	6	6	7		5	8	5		9	7	8

Test No. 4. Subtract. Time limit, 1 minute.

[With pencil.]

974	1574	1320	6000	7906
238	680	743	143	528

Practice No. 4. Practice subtracting.[1]

1.	842	1425	1540	8000	7906
	137	970	818	397	469
2.	367	1122	1307	7000	5707
	249	560	535	132	239
3.	431	1643	1450	9000	9603
	273	970	792	424	127
4.	567	1753	1604	5000	8906
	172	980	832	237	798
5.	953	1547	1750	6000	4805
	328	690	942	432	329
6.	875	1364	1130	7000	7608
	329	570	243	547	429

[1] Pupils failing on a particular type of problem may practice upon it by working the problems in the column that contains it.

Test No. 5. Add. Time limit, 5 minutes.

[With pencil.]

5436	2763	7318	6226	9244
2753	3586	6634	3785	5528
4329	4631	9442	8558	4273
2478	4209	5493	5347	7054
3691	5768	3746	7166	3599

Practice No. 5. Practice adding. *Work rapidly, but at the same time carefully.*

1.	5463	4745	3448	8976	9807
	3439	3757	9387	4988	6988
	3556	5890	6589	3779	5659
	4537	5458	3456	2564	3546
	7585	8796	1357	1433	3124
2.	2455	2437	6546	3654	5534
	3447	6345	6455	4563	4334
	5442	5438	8465	3544	6546
	5535	6497	9678	3258	3999
	2448	3764	3897	4545	4568

III. Progress Score

Try, within a limit of 5 minutes, to make a score of 100 points on this exercise. The number of points to be counted for each correct answer is given in parenthesis below the letter of the problem.

Add: [Write answers on the folds of a paper.]

A.	B.	C.	D.	E.
3	42	725	6342	$27.64
(7) 7	(10) 76	(12) 327	(15) 1350	(16) 18.32
8	38	218	4673	25.40
6	49	767	7598	16.75
9	24	277	6387	37.98

Subtract:

F.	G.	H.	I.	J.
26	84	752	5000	$60.75
(5) 9	(5) 27	(7) 389	(11) 2319	(12) 32.38

4. Earning Money

Men working at a trade are often paid either by the day or by the hour.

(1) The painter working on this building earns \$5.75 a day. How much does he earn in a month of 26 working days?

(2) The painter works 8 hours a day. What are his wages per hour?

(1)

The painter's earnings for a month are the product of \$5.75 and 26.

\$5.75 multiplied by 26 = ?

\$5.75	Multiplicand
26	Multiplier
34 50	
115 0	
\$149.50	Product

The month's earnings = \$149.50.

(2)

The painter's wages per hour are $\frac{1}{8}$ of \$5.75, or \$5.75 divided by 8.

\$5.75 ÷ 8 = ?

	\$.71$\frac{7}{8}$	Quotient
Divisor 8	\$5.75	Dividend

The wages per hour = \$.71$\frac{7}{8}$.

Test: \$.71 × 8, + 7¢ = \$5.75.

[Without pencil.]

1. Why, in solving the first problem above, was it necessary to multiply one number by the other? Why, in solving the second problem, was it necessary to divide?

2. Name the terms used in multiplication. Which term is the number that is taken a given number of times? Which shows how many times the number is to be taken? Which shows the result?

3. Name the terms used in division. Which term is the number that is divided? Which is the number by which the division is made? Which is the answer?

4. When a division comes out uneven, the number left from the last subtraction is called a **remainder**. Above what number is a remainder written in the quotient?

5. In multiplication, a product is usually tested by multiplying a second time. What test is used in division?

[With pencil.]

Find how much is due a workman:

6. For 8 hours of work at 65¢ an hour.

7. For 9 hours of work at 45¢ an hour.

8. For 5 hours of work at 85¢ an hour.

9. For 4 days of work at $6.50 a day.

10. For 21 days of work at $7.20 a day.

11. For 5 weeks of work at $33.50 a week.

12. How much is earned an hour by a man working 8 hours for $3.60? By a man working 7 hours for $5.25? By a man working 8 hours for $6.00?

13. How much more is earned a day by a man working 6 days for $45 than by a man working 6 days for $32.40? [1]

14. A skilled workman earns $45 a week; an unskilled workman, $30 a week. The difference in their earnings amounts to how much in a year of 52 weeks?

15. Find the difference in a year's wages earned by a man receiving $65 a week and those of a man receiving $40 a week.

*16. How much more is earned per hour by a man working 40 hours a week for $35 a week than by a man working 48 hours for $30.80?

[1] THE SOLUTION OF PROBLEMS: In solving problems containing two or more steps, the pupils should form the habit of thinking through each problem before beginning to compute. The following directions will prove helpful:

1. Find what the problem calls for.
2. Explain how to find the answer required.
3. Do the necessary work.

5. Review of Multiplication and Division Facts

[Without pencil.]

The following exercise contains the numbers that are most likely to give trouble in multiplication. Practice giving their products in two ways; for example: $7 \times 8 = 56$; $8 \times 7 = 56$:

1.	6	8	7	9	12	7	9	8	12	3
	4	6	6	6	6	5	7	7	7	8
2.	4	8	12	3	11	4	12	11	12	12
	8	9	8	9	11	9	4	12	12	9

In the columns below will be found some of the numbers that give trouble in division. Practice dividing the numbers in each column by the number above the brace at the top:

3. 6		4. 7		5. 8		6. 9		7. 12	
18	21	28	30	32	39	27	30	48	50
30	32	49	52	24	25	54	60	72	75
42	45	42	44	48	50	63	90	32	140
54	58	35	40	56	59	72	77	84	90
48	50	56	58	96	98	108	110	108	112
66	70	84	87	64	70	45	50	96	100
72	73	63	67	72	75	36	42	144	150

8. What is $\frac{1}{4}$ of 40? What is $\frac{3}{4}$ of 40?

To find $\frac{3}{4}$ of 40, divide 40 by 4, then multiply the quotient by 3.

9. How is $\frac{2}{3}$ of 15 found? $\frac{4}{5}$ of 20? $\frac{7}{8}$ of 24? $\frac{5}{12}$ of 60?

Find:

10. $\frac{2}{3}$ of: 12, 9, 24, 27, 36.
11. $\frac{3}{4}$ of: 16, 20, 24, 28, 48.
12. $\frac{4}{5}$ of: 15, 25, 35, 40, 50.
13. $\frac{5}{6}$ of: 12, 24, 18, 30, 42.
14. $\frac{6}{7}$ of: 21, 35, 42, 63, 70.
15. $\frac{7}{8}$ of: 16, 40, 24, 80, 96.
16. $\frac{8}{9}$ of: 27, 36, 54, 81, 99.
17. $\frac{7}{12}$ of: 36, 60, 72, 96, 108.

These tests will help you master the facts you need to know in order to multiply and divide. Practice on each until you can write the answers correctly.

[Write answers on the folds of a paper.]

Test No. 6. Multiplication. Time allowance for each set of 12 problems 1½ minutes.

1. 67	49	81	92	84	76
2	2	2	4	4	4
90	72	84	35	61	79
8	8	8	8	8	8
2. 74	95	86	90	82	51
3	3	3	6	6	6
63	74	70	61	84	53
6	6	9	9	9	9
3. 92	78	56	83	90	67
9	9	9	5	5	5
93	80	61	52	74	89
7	7	7	7	7	7

Test No. 7 Division. Time allowance for each set of 6 problems, 1½ minutes.[1]

[With pencil.]

1. 2|192	2|174	4|384	4|300	8|480	8|568
2. 8|736	8|664	8|432	3|234	3|207	3|162
3. 6|486	6|552	6|438	6|336	6|240	5|380
4. 5|415	5|160	7|581	7|434	7|497	7|378
5. 7|646	9|720	9|630	9|567	9|486	9|828

[1] [illegible] may be written on a piece of paper held below dividends, or problems [illegible] before timing pupils.

6. The Name, or Denomination, of Terms in Multiplication

I

What is the product when 16 bushels is multiplied by 14? When 18 pounds is multiplied by 60? When $1.25 is multiplied by 102?

16 bu. × 14 = ?	18 lb. × 60 = ?	$1.25 × 102 = ?
16 bu.	18 lb.	$1.25
14	60	1 02
64	1080 lb.	2 50
16		125
224 bu.		$127.50

Which terms in multiplication are given the same name? Which term means *times* and can have no other name given it?

[With pencil.]

Multiply, labeling each product:

1. 48 dozen by 8.
2. 142 feet by 16.
3. 196 pounds by 24.
4. $1.75 by 44.
5. $325 by 122.
6. 148 barrels by 76.
7. 124 bushels by 104.
8. 304 yards by 324.

9. In finding the cost of 24 barrels of apples at $4.25 a barrel, will the product be barrels or dollars and cents? How do we know which number is to be used as the multiplicand?

10. One hundred fourteen boxes of freight each weighing 165 pounds are to be shipped. In finding the weight of the entire number of boxes, which number will be used as the multiplicand? Why?

11. Find the cost of 18 bushels of potatoes at $1.95 a bushel.

12. A bushel of corn weighs 56 pounds. What is the weight of 42 bushels?

13. John's mother orders 3 pounds of butter at 64¢ a pound; 4 dozen eggs at 70¢ a dozen; and a dollar's worth of sugar. Find the amount of her bill.

II

[Use pencil only when needed.]

1. What is the difference between the product of 3 times 4 and that of 4 times 3?

2. What is the difference between the product of 20 times 10 and that of 10 times 20?

The position of the multiplicand and the multiplier may be changed without altering the value of the product.

Arrange in the most convenient way and multiply:

3. 43 by 832.	7. 2114 by 21.	11. 218 by 3342.
4. 51 by 4892.	8. 75 by 4321.	12. 807 by 1634.
5. 1024 by 32.	9. 207 by 48.	13. 3969 by 630.
6. 35 by 1225.	10. 68 by 406.	14. 78 by 12,940.

III

At 8¢ a pound, how much must be paid for 16 lb. of flour?

$16 \times 8 = 8 \times 16$.

$$\begin{array}{r} 16 \\ 8 \\ \hline \$1.28 \end{array}$$

The cost of the flour is $1.28.

In solving this problem, since it is more convenient to multiply 16 by 8 than 8 by 16, the denominations of the terms are omitted, and the positions of the multiplicand and the multiplier are changed.

[With pencil.]

1. Multiply: 9 lb. by 122; 7 yd. by 21; 6¢ by 312; 15¢ by 125; $25 by 244.

Find the cost:

2. Of 24 pounds of rice at 18¢ a pound.
3. Of 3 dozen oranges at $.58 a dozen.
4. Of 4 barrels of apples at $4.75 a barrel.
5. Of 196 pounds of flour at 7¢ a pound.

6. Of 15 pounds of butter at $.62 a pound.

7. Of 25 pounds of sugar at 12¢ a pound.

8. Of 24 cakes of soap at 7¢ a cake.

9. Of 105 feet of wire at 3¢ a foot.

10. Of 2 dozen lemons at 48¢ a dozen and 4 pounds of California grapes at 16¢ a pound.

11. Of 18 glass jars at 12¢ apiece and 24 jelly glasses at 6¢ apiece.

*12. Find the amount of change from a ten-dollar bill in paying for 12 boxes of blueberries at 30¢ a box, and 2 bushels of pears at 60¢ a peck.

7. Practice in Multiplication

Multiply: [With pencil.]

1. 32 by 22.	6. 242 by 14.	11. 246 by 322.
2. 42 by 23.	7. 32 by 132.	12. 425 by 204.
3. 36 by 25.	8. 204 by 43.	13. 522 by 305.
4. 64 by 75.	9. 325 by 34.	14. 417 by 327.
5. 58 by 46.	10. 42 by 245.	15. 22 by 1208.
16. 67 by 76.	21. 454 by 87.	26. 876 by 628.
17. 78 by 89.	22. 567 by 89.	27. 609 by 287.
18. 98 by 87.	23. 807 by 96.	28. 679 by 207.
19. 87 by 79.	24. 689 by 79.	29. 908 by 689.
20. 96 by 198.	25. 798 by 68.	30. 8064 by 709.

8. Practice in Short Division

[With pencil.]

1. The railway distance across our country from Boston to San Francisco is 3313 miles. A through sleeping car is hauled this distance in 4 days. How can the average distance that it is carried each day be found? Find it.

2. Divide: 984 by 3; 1809 by 5; 697 by 8.

3. Find the number of weeks there are in a year of 365 days.

4. How many months of 4 weeks each are there in 52 weeks?

5. A mile contains 5280 feet. How many yards does it contain?

Find quotients, testing each when found:

6. 3)852	10. 8)3072	14. 8)7808	18. 7)4706
7. 4)812	11. 7)14028	15. 9)7650	19. 7)1575
8. 5)1600	12. 6)1920	16. 6)5927	20. 8)16320
9. 6)535	13. 9)8069	17. 7)35560	21. 8)6157

22. Divide the sum of 482 and 726 by 4. What is the quotient?

Find the sums, and then the quotients, as indicated:

23. 242	24. 564	25. 421	26. 579
343	442	313	876
257	347	143	585
348	542	235	948
2[ ] Sum	5[ ]	4[ ]	3[ ]
Quotient			

27. Find the difference between 150,750 and 118,502. Divide this difference by 8.

*28. Find the difference between the product of 25 and 412 and that of 75 and 742. Divide this difference by 5.

9. Review of Long Division

I

Long division is the same process as short division. The only difference is that in short division much of the work is carried in the mind, while in long division most of it is written down.

How many times is 21 contained in 6804?

6804 ÷ 21 = ?

```
     324
21|6804
   63
    50
    42
     84
     84
```

21 is contained in 68, 3 times. The 3 is written in the quotient. The divisor 21 is then multiplied by 3. $3 \times 21 = 63$. The product 63 is subtracted from 68, leaving a remainder 5. The next figure in the dividend (0) is written with the remainder (5) to form the new dividend 50.

21 is contained in 50, 2 times. The 2 is written in the quotient, and the divisor is multiplied by it. $2 \times 21 = 42$. Subtracting the product 42 from 50, we find the remainder 8. The next figure in the dividend (4) is written with the 8 to form the new dividend 84.

21 is contained in 84, 4 times. The 4 is written in the quotient, and the divisor is multiplied by it. $4 \times 21 = 84$. Subtracting the product 84 from the dividend, we find that there is no remainder. 6804 ÷ 21 = 324.

In long division, we follow these directions: (1) **Divide**; (2) **multiply**; (3) **subtract**; (4) **bring down a new figure.** These directions we follow over and over again, until the last figure to the right in the dividend has been used.

When it is hard to determine a figure in the quotient, the first figures of the divisor and the dividend are used as guides. To determine how many times 21 is contained in 68, 6, the first figure of the dividend, is divided by 2, the first figure of the divisor. Since 6 divided by 2 equals 3, we conclude that 68 divided by 21 is 3.

Sometimes it is necessary to try two or three figures in the quotient before the right one is found. We multiply the divisor by the trial figure. If the product found is larger than the part of the dividend used, the figure in the quotient must be made a smaller number. If, after subtracting the product from the dividend, the remainder found is equal to or larger than the divisor, the figure in the quotient must be made a larger number.[1]

[With pencil.]

1. Divide: 4473 by 21; 713 by 23; 7750 by 25.

2. A school of 550 children is to go on a picnic. How many trolley cars, each holding 50 children, are required to carry the school to the picnic grounds?

[1] This testing of the figure in the quotient should be done mentally. The figure should be written only after it is found to be correct.

3. Twenty-four benches are bought with which to equip a school workshop. The amount paid for them is $576. The benches cost how much apiece?

4. Land for a summer camp was bought for $2500. How much was paid per acre, if the number of acres bought was 20?

*5. A wood lot containing 24 acres was sold for $5088; a meadow lot containing 31 acres, for $3410. Find the difference in the price per acre.

*6. Oats weigh 32 lb. to a bushel. Estimate, and then find, how many bushels there are in a load weighing 1344 lb.

Find the value of:

7. 5103 ÷ 21.	12. 4686 ÷ 32.	17. 46,948 ÷ 22
8. 7084 ÷ 22.	13. 7176 ÷ 31.	18. 525 ÷ 25.
9. 8862 ÷ 42.	14. 792 ÷ 24.	19. 40,951 ÷ 31.
10. 5232 ÷ 24.	15. 7514 ÷ 34.	20. 53,176 ÷ 23.
11. 5825 ÷ 25.	16. 4356 ÷ 31.	21. 10,044 ÷ 31.

II

130,968 ÷ 321 = ?

```
        408
321|130968
    1284
      2568
      2568
```

Test: 408 × 321 = 130,968

In writing the quotient, care should be taken to place the first figure directly above the last figure in the part of the dividend used; and, after that, to place one figure in the quotient for each of the remaining figures in the dividend.

In dividing 130,968 by 321, the first part of the dividend used is 1309. The first figure in the quotient is, therefore, written above the 9, and the total number of places in the quotient is three. One figure is written above the 9, the next above the 6, and the last above the 8.

When the new dividend formed is too small to contain the divisor, a cipher is written in the quotient, and another figure is added to the partial dividend.

In the problem above, in subtracting 1284 from 1309, the remainder found

was 25, and the first new dividend formed was 256. Since 256 is less than the divisor 321, a cipher was written in the quotient, and the next figure (8) in the dividend was written with 256, forming the new dividend 2568.

Divide: [With pencil.]

1. 10,500 by 42.
2. 89,040 by 742.
3. 74,844 by 324.
4. 11,050 by 25.
5. 103,320 by 420.
6. 77,440 by 242.
7. 173,664 by 864.
8. 76,125 by 375.
9. 31,408 by 302.
10. 645,272 by 316.
11. 126,360 by 54.
12. 742,632 by 232.
13. 48,000 by 32.
14. 976,720 by 421.
15. 1,399,189 by 409.

III

3079 ÷ 49 = ?

```
      62 41/49
49|3079
   294
    139
     98
     41
```

Test: 62 × 49 + 41 = 3079

In this problem, since the divisor 49 is so near 50 in value, in finding the different figures in the quotient the number 5 is used as a guide instead of the number 4. For example, from the fact that 5 is contained in 30, 6 times, we are quite certain that 49 is contained in 307, 6 times.

[Use pencil for problems.]

1. What figure would you use as a guide in dividing a number by 68? In dividing by 89? In dividing by 779?

2. Divide 4025 by 19; 13,108 by 29; 21,529 by 78.

3. A man earns $980 on a job requiring 28 weeks. His earnings are how much per week?

4. A carload of 19 cattle is sold for $798. This is how much for each head of cattle?

5. A warship covering 609 miles in 29 hours travels at what rate of speed per hour?

*6. A fast express train covers a distance of 992 miles in 16 hours; a fast steamship, 756 miles in 28 hours. What is the difference in the rate of travel per hour?

10. Practice in Long Division

Find quotients. Practice on each set of problems in which you make mistakes until you can solve them quickly and correctly.

[With pencil.]

A.	C.	E.
1. 21)672	15. 59)25429	29. 213)66882
2. 32)4320	16. 48)35184	30. 412)150380
3. 63)26838	17. 69)58236	31. 322)1356586
4. 83)44903	18. 87)81345	32. 421)54730
5. 94)50384	19. 78)51486	33. 150)4650
6. 72)44928	20. 47)25850	34. 750)156000
7. 81)25434	21. 58)518640	35. 923)647946
B.	**D.**	**F.**
8. 33)6930	22. 77)53284	36. 487)31168
9. 25)5500	23. 68)93160	37. 692)53284
10. 43)19780	24. 87)42717	38. 392)170128
11. 62)24986	25. 54)36936	39. 789)427638
12. 72)36216	26. 27)15930	40. 662)51636
13. 63)63945	27. 56)16440	41. 117)78624
14. 23)46460	28. 57)96330	42. 842)244180

11. A Country Store

[Use pencil only when needed.]

1. What are some of the things sold in country stores?

Find how much must be paid:

2. For 2 lb. of tea at 60¢ a pound, and a box of crackers at 7¢.

3. For 2 milk pails at $1.25 apiece.

4. For a clothes basket for $2.25 and a clothesline for 60¢.

5. For 8 yards of calico at 12¢ a yard and 2 spools of thread at 5¢ a spool.

6. For a rake for $1.25, a spade for $1.75, a shovel for $2.00, and a hoe for $1.00.

7. How much change should be received from a dollar bill in buying a can of coffee at 60¢ a can?

Find the change:

8. From 3 quarters in buying ½ dozen milk bottles for 60¢.

9. From a dollar bill in buying a broom for 65¢.

10. From a two-dollar bill in buying a teakettle for $1.45 and a baking dish for 40¢.

11. Quart jars for canned fruit are selling for $1.20 a dozen. How much is this apiece?

12. At 75¢ a dozen, how many jelly glasses can be bought for 25¢?

13. Sugar is selling at 12¢ a pound. How many pounds can be bought for 60¢? For $1.20?

[With pencil.

14. Mrs. Brown sells to the store 12 lb. of butter at 68¢ a pound and buys a dollar's worth of groceries. How much is due her?

15. Mrs. Clark sells to the country store 4 dozen of eggs at 60¢ a dozen and 3 fowls at $1.45 apiece, and buys dry goods amounting to $8.00. How much does she owe the store?

16. Mr. Johnson sells to the store 12 bushels of potatoes at $2.00 a bushel, and buys 3 milk cans at $2.25 each. How does his account stand?

17. First estimate, and then find, how many barrels of flour at $14.00 a barrel should be given in exchange for 21 barrels of apples at $4.00 a barrel.

*18. Find the number of yards of cloth at 82¢ a yard that should be given in exchange for 8 pounds of butter at 52¢ a pound and 4 dozen eggs at 60¢ a dozen.

*19. With the help of advertisements cut from a newspaper, make a price list of goods that might be sold in a country store. Use this price list for making and solving problems of your own.

12. Sending Money by Mail

To prevent loss of money in the mails, post offices sell slips of paper called money orders, which may be sent in a letter instead of money. The following table shows how much is charged for money orders worth from 1¢ to $20.00:

FEES FOR MONEY ORDERS

For orders from	$0.01 to $2.50	.....	3 cents.
from	$2.51 to $5.00	.....	5 cents.
from	$5.01 to $10.00	.....	8 cents.
from	$10.01 to $20.00	.....	10 cents.

A person taking out a money order gives the clerk who fills out the order the amount of money to be sent, together with the cost of the order.

[Without pencil.]

1. I wish to send $2.50 to my cousin who lives in another city. In taking out a money order for that amount, what fee must I pay? How much money must I give the clerk in the post office?

2. How much money must be given the clerk in taking out an order for $5.00? For $10.00? For $15.00?

3. Fred sent a money order for a subscription to the "Youth's Companion" costing $2.50. How much money did he need?

4. How much money must be given the postal clerk in order to send a three-dollar subscription to the "St. Nicholas"?

5. Margaret has $1.50 with which to send an order for flower seeds. Out of this amount, she must make an allowance of 3¢ for the cost of a money order, and of 12¢ for postage. How much money will she have left with which to pay for the flower seeds?

[With pencil.]

6. Henry writes to New York for a sweater costing $7.50, and a boy-scout suit costing $9.75. He is to enclose in his letter a money order covering the cost of the two articles. How much money must he give the postal clerk?

7. Frank orders by mail a copy of "The Boys' Book on Handicraft," costing $1.25. He takes out a money order to cover the cost of the book and 12¢ for postage. In paying for the order, how much change should he receive from a two-dollar bill?

8. In taking out a money order for $5.00, how much change should be received from a ten-dollar bill?

9. How much change should be received from a five-dollar bill in taking out one order for $2.75 and another for $1.25?

*10. Marjorie orders her Christmas presents by mail. Find the sum of money that she must give a postal clerk for a money order covering the cost of a work basket at $.75, a pocket-book at $.95, a doll at $1.25, a toy village at $1.50, and 2 story books at $.75 apiece.

*11. With the help of this price list, choose three books that you would like to order. Find the cost of sending a money order to cover the price of the three and 15¢ postage.

Arabian Nights, $.50	Nights with Uncle Remus, $2.00
Andersen's Fairy Tales, $.45	The Jungle Book, $1.50
Grimm's Fairy Tales, $.45	Five Little Peppers, $1.50
Robinson Crusoe, $.75	Hans Brinker, $.50
Alice in Wonderland, $.45	The Dutch Twins, $.64
Boys' Book of Electricity, $1.50	Song of Hiawatha, $.44
Girls' Book of Handicraft, $1.60	Story-Telling Poems, $1.10

13. Buying Thrift Stamps

A good way of saving money is to buy thrift stamps at the post office. These cost 25¢ apiece. When you have $4.00 worth, if you pay a small sum in addition, you can exchange the thrift stamps for a war savings stamp, which in five years, when due, is worth $5.00. If you make the exchange in January, you pay 12¢, if, in February, 13¢. For other months see the table below.

Jan., 12¢	Apr., 15¢	July, 18¢	Oct., 21¢
Feb., 13¢	May, 16¢	Aug., 19¢	Nov., 22¢
Mar., 14¢	June, 17¢	Sept., 20¢	Dec., 23¢

[Use pencil only when needed.]

1. At 25¢ apiece how many thrift stamps can you buy for 50¢? For $1.00? For $1.50?

Complete, then make other statements like these:

2. At 25¢ apiece 2-thrift stamps are worth ——.

3. Saving 5¢ a day it takes —— days to save enough money to buy 2 thrift stamps.

4. I have $4.00 worth of thrift stamps. If I exchange them for a war savings stamp in October, I shall have to pay in addition the sum of —— cents.

Complete:

5. If I own 10 war savings stamps worth $5.00 apiece, I can collect from the post office —— dollars when the payment is due.

6. I own a savings stamp worth $5.00 for which I gave $4.00 worth of thrift stamps and 20¢. This is a gain of —— cents.

7. When $4.22 is paid for a $5.00 stamp the gain is —— cents.

8. A gain of 80¢ on a stamp means a gain of —— on 2 stamps.

9. A gain of 82¢ on a stamp means a gain of —— on 5 stamps.

10. A gain of 88¢ on a stamp means a gain of —— on 10 stamps.

11. Make other statements like those above.

14. Problem Review and Test[1]

[Without pencil.]

1. What is the value in cents of a quarter and 3 dimes?

2. How much change should be received from 50¢ in buying a paint box for 35¢?

3. Name a set of coins that might be received as change from a dollar bill in buying 4 notebooks at 10¢ apiece.

4. What is the difference in value between 2 quarters and 3 dimes?

[1] A good method of giving a mental test and at the same time overcoming the individual difficulties of the pupils is as follows: Have before each pupil a slip of paper on which he writes his name and the necessary figures for numbering the answers to the problems to be given. Dictate slowly and distinctly the problems. After each is read, wait a moment so that the children may all have time to solve the problem, then give the signal, "Write," whereupon the entire class write their answers. At the close of the exercise, have the pupils exchange papers and then, as the teacher or one of the pupils reads the correct answers, have each answer marked C (Correct) or X (Wrong). Then have the papers returned to their owners and ask the pupils who failed on the first problem to stand. Find out their difficulties and give them the necessary help. In the same way, help the pupils who failed on the second problem, and then those who failed on each of the other problems.

Short tests of this kind may very profitably be given two or three times a week. When carefully planned, the time required for a test containing five problems need not be more than ten minutes.

5. How many dimes should be received for 6 quarters?

6. A boy earns 5¢ a day helping his father and 10¢ helping his mother. Find how much he earns in 6 days.

7. Suppose you earn 25¢ a week out of which you spend 10¢. How much would you save in 2 weeks?

8. If you save 10¢ a week, how much money will you have in 10 weeks?

9. How much more money will I have in 4 weeks if I save 15¢ a week than if I save 10¢ a week?

10. A girl puts 20¢ in her new bank on the first day that she has it. The next day she puts in 30¢. The day after that she takes out half of what she had put in. How much does she take out?

11. A boy's allowance is 20¢ a week. One week he saves $\frac{1}{2}$ of it. The next week $\frac{3}{4}$ of it. How much does he save?

12. At 25¢ a piece how many thrift stamps can be bought for 75¢?

13. At $4.12 apiece how much must be paid for 2 war savings stamps?

14. A boy paid $4.20 for a war savings stamp for which, when due, he can collect $5.00 from the post office. This is how much more than he paid for the stamp?

15. A girl took out a money order for $2.75 and paid a fee of 5¢. How much change should she receive from 3 one-dollar bills?

16. A laundress works at 30¢ an hour from 8 o'clock in the morning until 5 o'clock in the afternoon. How much is due her if no deduction is made for the noon hour?

17. Coal is selling at $12.00 a ton. How much should be paid for $\frac{1}{2}$ ton?

18. A man works 8 hours a day for $4.80. How much does he receive for each hour's work?

[With pencil.]

19. How much should be paid for 3 dozen eggs at 58¢ a dozen, 5 pounds of butter at 62¢ a pound, and 1 sack of flour for 75¢?

Find the total amount due on the items in each problem: [1]

20. 1 sweater @ $7.75.
3 football suits @ $9.25.
1 football @ $2.98.

21. 2 baseballs @ $1.25.
1 bat @ 65¢.
1 glove @ $1.35.

22. 3 doz. eggs @ 72¢.
2 lb. butter @ 68¢.
2 lb. coffee @ 60¢.
3 boxes of crackers @ 7¢.

23. 3 loaves of bread @ 12¢.
½ lb. tea @ 90¢.
10 lb. sugar @ 12¢.
6 cans of tomatoes @ 25¢.

24. 2 games @ 25¢.
1 box paper @ 25¢.
2 books @ 98¢.
1 fountain pen @ $1.25.
1 box paints 75¢.

25. 3 yd. silk @ $2.25.
2 yd. lining @ 25¢.
6 yd. braid @ 28¢.
3 spools thread @ 5¢.
2 doz. buttons @ 40¢.

26. Find the amount of change that should be received from a ten-dollar bill in paying for 1 barrel of apples at $5.75, and a bushel of potatoes at $2.25.

27. At 25¢ a day, how many days does it take to save $8.75?

28. How much does it cost to heat and light a house for 8 months, if the heating costs $7.25 a month and the lighting $1.48 a month?

29. A man earns $1820 per year. How much are his earnings per week (52 weeks)? Per month (4 weeks)?

30. A young man earning $75 a month saves ⅕ of his salary. How much does he save in a year's time?

31. For safe-keeping, I put into the bank $25, $10, $50, and $35. Later I take out $4.75, $12.50, $9.50, $2.48, and $12.75. Find how much I have left in the bank.

[1] When an item in a bill reads *2 baseballs @ $1.25*, the sign @ is read *at* and the word *each* is understood after $1.25. In the item *3 doz. eggs @ 52¢*, the words *a dozen* are understood after *52¢*.

15. Tests for Speed and Accuracy[1]

These tests are to help you further in learning to compute accurately and with speed. If, within the time limit, you fail to get the correct answers to all of the problems in a test, practice solving the problems of the same kind on pages 272–275, then try the test again.

[Copy problems only when necessary.]

Test No. 8. Add. Time limit, 3½ minutes.

A.	C.	D.
5432	5	479
1457	4	384
5468	7	269
1340	6	543
4679	8	766
	9	348
	5	457
B. 3214	6	543
4378	5	
23645	8	
4876	4	
35228	5	

Test No. 9. Subtract. Time limit, 45 seconds.

E. 17659	
8470	
F. 5000	
1324	
G. 68434	
4559	

Test No. 10. Multiply. Time limit, 3¼ minutes.

H.	I.	J.	K.
7608	674	826	758
9	80	79	503

Test No. 11. Divide. Time limit, 5½ minutes.

L.	M.	N.	O.
7)66559	62)43896	292)15184	54)26568

If you had no trouble with the test above, try to get the correct answers to these problems:

*1. 9768 × 798 = ? *2. 1,398,061 ÷ 162 = ?

[1] While a class as a whole is working on the Fractional Part in Chapter II, those pupils who are below the standards on the tests above should be given extra time daily for practice, using the exercises on pages 272–275.

16. Progress Score

This exercise and the others like it through the book are to help you measure your progress in computing. Try, within a limit of 12 minutes, to make a score of 100 points. The number of points to be counted for each correct answer is given in parenthesis below the letter of the problem.

[Copy problems only when necessary.]

Add:

A.	B.	C.	D.	E.
(4) 3	(5) 24	(6) 247	(7) 4238	(7) $17.29
4	16	341	6425	8.76
2	36	38	2403	4.85
7	42	217	2739	7.69
8	74	148	2844	13.27
9	13	329	1478	26.36

Subtract:

F.	G.	H.	I.	J.
(3) 35	(3) 90	(4) 800	(4) 4293	(5) $50.00
8	42	372	387	32.18

Multiply:

K.	L.	M.	N.
(4) 4830	(7) 3246	(7) 927	(9) $74.36
7	83	306	324

Divide:

O.	P.	Q.
(7) 8|76833	(8) 213|68160	(10) 495|227750

CHAPTER II. THE FRACTIONAL PART

17. Some Uses for the Fractional Part[1]

[Without pencil.]

1. In order to get the dimensions of the patterns on page 31, first study this ruler:

Find on the ruler: 1 inch, $\frac{1}{2}$ inch, $1\frac{1}{2}$ inches, $\frac{1}{4}$ inch, $1\frac{1}{4}$ inches, $\frac{3}{4}$ of an inch, $1\frac{3}{4}$ inches.

2. What sign is used for inches?

3. Point out on the ruler: $\frac{1}{8}''$, $\frac{5}{8}''$, $1\frac{3}{8}''$, $1\frac{5}{8}''$, $2\frac{7}{8}''$.

Name the length of line that equals:

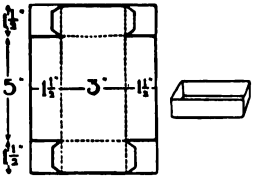
4. $\frac{1}{2}'' + \frac{1}{2}''$.
5. $1\frac{1}{2}'' + \frac{1}{2}''$.
6. $2\frac{1}{2}'' + \frac{1}{2}''$.
7. $\frac{1}{4}'' + \frac{1}{4}''$.
8. $1\frac{1}{4}'' + \frac{1}{4}''$.
9. $2\frac{1}{4}'' + \frac{1}{4}''$.
10. $\frac{3}{4}'' + \frac{1}{4}''$.
11. $\frac{3}{8}'' + \frac{1}{8}'' + \frac{1}{8}''$.
12. $2\frac{3}{8}'' + \frac{1}{8}'' + \frac{1}{8}''$.

13. The dimensions of the patterns on the next page are given in inches. Find the length and the width of the material required for each article.

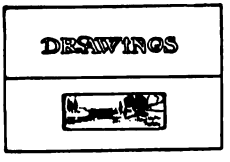
Such parts of a quantity as one half ($\frac{1}{2}$), one fourth ($\frac{1}{4}$), three fourths ($\frac{3}{4}$), one eighth ($\frac{1}{8}$), and five eighths ($\frac{5}{8}$) are called **fractions.**

14. Name the fractions used with the whole numbers on the pattern for the tray. Name those used on the pattern for the portfolio.

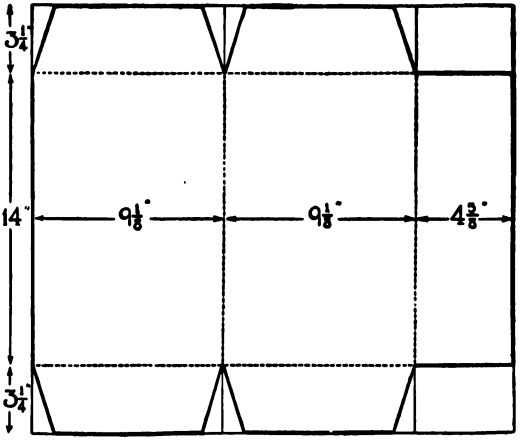
[1] The purpose of the first half of this chapter is to review former work in fractions and to lay a foundation for the technical treatment that comes later.



Tray



Portfolio



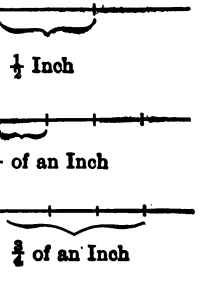
15. We have use for fractions in many of our daily transactions. In telling time, we speak of the half-hour and the quarter-hour. In measuring cloth by the yard, we commonly use halves, quarters, and eighths. In buying by the pound, we speak of halves and quarters. What parts of a dollar are used?

16. To what use are fractions put in carpentry? In cooking? In sewing?

17. Name other uses for fractions.

18. Practice in Finding Fractional Parts

[Use pencil for drawings only.]



1. In order to find ½ of an inch, an inch is divided into two equal parts. How is ½ of an apple found? How is ½ of any whole thing found?

2. Explain how to find ¼ of an inch. ¼ of a pie. ¼ of any whole thing.

3. How is ¾ of an inch found?

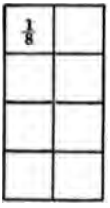
4. How is $\frac{3}{4}$ of a circle found? (Show by drawing.)

5. How is $\frac{3}{4}$ of any whole thing found?

The whole out of which a part is taken is called a **unit.**

An apple, a pie, a cake, a dollar, an inch, a yard, a pound, a circle, a square, a pile of books, or any other quantity thought of as a whole may be called a unit.

6. What is thought of as the unit in finding $\frac{1}{2}$ of an apple? In finding $\frac{1}{4}$ of an inch? In finding $\frac{3}{4}$ of a pound?



7. Fold a sheet of paper into fourths, and then each fourth into two equal parts. How many equal parts does the sheet now contain? What name is given to one of the equal parts? To 3 parts? To 5 parts? To 7 parts?

8. Give directions for finding $\frac{1}{8}$ of a sheet of paper. For finding $\frac{1}{8}$ of an inch. For finding $\frac{1}{8}$ of any unit.

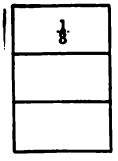
9. Draw a line. Divide it into eighths, then erase $\frac{3}{8}$ of it. What part of the line is left?

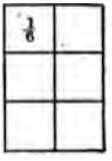
10. Draw a rectangle and shade $\frac{5}{8}$ of it.

11. Explain how to find $\frac{3}{8}$ of a cake. $\frac{5}{8}$ of a yard of ribbon. $\frac{7}{8}$ of a sheet of paper.

12. Give directions for finding $\frac{3}{8}$ of any unit. For finding $\frac{5}{8}$. For finding $\frac{7}{8}$.

13. What name is given to each part when a unit is divided into three equal parts? When it is divided into six equal parts?





14. Fold a paper into three equal parts. Find one third of the sheet. Find two thirds.

15. Fold a paper into six equal parts. Find one sixth of the sheet. Find five sixths of the sheet.

16. Draw two circles. Shade $\frac{2}{3}$ of one and $\frac{5}{6}$ of the other.

17. Explain how to find $\frac{2}{3}$ of a pie. $\frac{5}{6}$ of a pie.

18. Give directions for finding $\frac{2}{3}$ of any unit. For finding $\frac{5}{6}$.

19. One of four equal parts of a unit is called one fourth. What is one of five equal parts called? One of ten equal parts? One of twelve equal parts?

20. Give directions for finding $\frac{1}{8}$ of a unit. For finding $\frac{1}{10}$. For finding $\frac{1}{12}$.

19. Grouping and Separating Parts[1]

[Use pencil for drawings only.]

1. If you had 3 oranges and cut each in half, how many pieces would you have?

2. How many half-oranges are there in 1 orange? In 2 oranges? In 3? In $1\frac{1}{2}$ oranges? In $2\frac{1}{2}$?

3. Draw two equal rectangles and divide each into thirds. How many thirds are there in 1 rectangle? In 2 rectangles? In $1\frac{1}{3}$?

4. Draw two lines each a yard long. Divide each into fourths. Find how many fourths of a yard in 1 yard. In 2 yards. In $1\frac{1}{4}$ yards.

5. $1 = \frac{?}{2}$. $2 = \frac{?}{2}$. $1\frac{1}{2} = \frac{?}{2}$.

6. $1 = \frac{?}{3}$. $2 = \frac{?}{3}$. $1\frac{1}{3} = \frac{?}{3}$.

7. $1 = \frac{?}{4}$. $2 = \frac{?}{4}$. $1\frac{1}{4} = \frac{?}{4}$.

8. $4 = \frac{?}{2}$. $5 = \frac{?}{3}$. $3\frac{1}{4} = \frac{?}{4}$.

9. Two halves of an orange are put together. How many oranges do they make?

10. Four half-oranges are equal to how many oranges?

11. A number of circles of equal size are each cut into thirds. How many whole circles can be made out of 3 of the thirds? Out of 6 of the thirds?

[1] See footnote, page 30.

12. I have several strips of ribbon each a fourth of a yard long. How many yards are there in 4 of the strips? In 8 of them? In 12 of them?

Find the number of units in each of the following:

13. $\frac{2}{2}$; $\frac{4}{2}$; $\frac{6}{2}$; $\frac{8}{2}$.

14. $\frac{8}{8}$; $\frac{9}{8}$; $\frac{6}{8}$; $\frac{7}{8}$.

15. $\frac{4}{4}$; $\frac{8}{4}$; $\frac{16}{4}$; $\frac{5}{4}$.

16. $\frac{5}{5}$; $\frac{15}{5}$; $\frac{10}{5}$; $\frac{6}{5}$.

17. $\frac{6}{6}$; $\frac{12}{6}$; $\frac{8}{6}$; $\frac{24}{6}$.

*18. $\frac{17}{17}$; $\frac{49}{8}$; $\frac{75}{7}$; $\frac{110}{9}$.

20. Changing Halves, Fourths, and Eighths to a Common Name

I

[Use pencil for drawings only.]

1. Which is the larger part of an apple, $\frac{1}{2}$ or $\frac{3}{4}$? $\frac{1}{2}$ or $\frac{4}{8}$?

2. How many fourths equal a half? How many eighths equal a half?

3. Compare $\frac{1}{4}$ of an apple with $\frac{3}{8}$ of the same apple. Which is the larger part?

4. How many eighths of an apple equal $\frac{3}{4}$ of it?

Complete:

5. $1 = \frac{?}{2} = \frac{?}{4} = \frac{?}{8}$.

6. $\frac{1}{2} = \frac{?}{4} = \frac{?}{8}$.

7. $\frac{1}{4} = \frac{?}{8}$ $\frac{3}{4} = \frac{?}{8}$.

8. $\frac{4}{4} = ?$ $\frac{2}{2} = ?$ $\frac{8}{8} = ?$

9. $\frac{3}{4} = ?$ $\frac{3}{8} = ?$

10. $\frac{4}{8} = ?$ $\frac{6}{8} = ?$

11. Divide a circle into fourths, then show the part of the circle that equals one fourth of the circle put with another fourth.

12. Show, by a drawing, the part of a circle that equals one eighth of the circle put with another eighth.

13. Draw $\frac{5}{8}$ of a circle. Erase one of the eighths. What part of the circle is left?

14. $\frac{1}{4} + \frac{1}{4} = \frac{?}{4} = \frac{?}{2}$.

15. $\frac{1}{8} + \frac{1}{8} = \frac{?}{8} = \frac{?}{4}$.

16. $\frac{3}{8} + \frac{1}{8} = \frac{?}{8} = \frac{?}{2}$.

17. $\frac{5}{8} + \frac{1}{8} = \frac{?}{8} = \frac{?}{4}$.

18. $\frac{5}{4} - \frac{1}{4} = \frac{?}{4} = ?$

19. $\frac{3}{8} - \frac{1}{8} = \frac{?}{8} = ?$

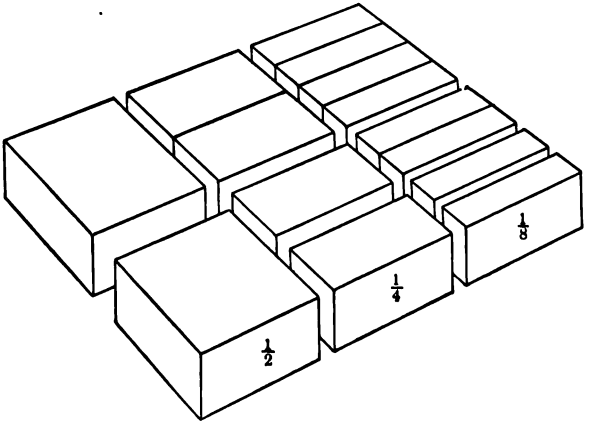
20. $\frac{5}{8} - \frac{1}{8} = \frac{?}{8} = ?$

21. $\frac{7}{8} - \frac{1}{8} = \frac{?}{8} = ?$

22. $\frac{7}{8} - \frac{3}{8} = \frac{?}{8} = ?$

*23. From $\frac{5}{8} + \frac{7}{8}$, subtract $\frac{3}{8} + \frac{3}{8}$. How many fourths are left?

II



[Without pencil.]

1. Into how many equal parts has each of these blocks been divided? Name the smallest division in each.

2. Which is the smallest part, $\frac{1}{2}$, $\frac{1}{4}$, or $\frac{1}{8}$?

3. The three blocks are all of the same size. If you should put $\frac{1}{2}$ of one with $\frac{1}{4}$ of another, what part of a whole block would you have?

4. One half equals how many fourths?

5. What is the sum of $\frac{1}{2}$ and $\frac{1}{4}$? What is their difference?

6. To what fraction is a half changed before it is added to or subtracted from fourths?

7. $1\frac{1}{2} + \frac{1}{4} = ?$ $2\frac{1}{4} + \frac{1}{2} = ?$ $1\frac{1}{2} - \frac{1}{4} = ?$ $2\frac{1}{2} - \frac{1}{4} = ?$

8. How many eighths equal one half?

9. From one half a cake, a piece equal to one eighth of the cake is cut. What part of the cake is left?

10. What part of a cake have I, if I put $\frac{1}{8}$ of the cake with $\frac{1}{2}$ of it?

11. To what fraction is a half changed before it is added to or subtracted from eighths?

12. $\frac{1}{2} + \frac{1}{8} = ?$ $\frac{1}{2} + \frac{3}{8} = ?$ $\frac{1}{2} - \frac{1}{8} = ?$ $\frac{1}{2} - \frac{3}{8} = ?$

13. Call the blocks in the drawings bricks of ice-cream. How many eighths are equal to one fourth of a brick? To three fourths?

14. If a boy were to eat $\frac{1}{4}$ of a brick of ice-cream, and his sister, $\frac{1}{8}$, what part of the brick would be eaten? What part would be left?

15. Make a problem about $\frac{3}{8}$ of a pound and $\frac{1}{4}$ of a pound of candy. Make one about $\frac{5}{8}$ and $\frac{1}{4}$.

16. To what fractional parts are fourths changed before they are added to or subtracted from eighths?

17. $\frac{1}{4} + \frac{1}{8} = ?$ $\frac{1}{4} + \frac{3}{8} = ?$ $\frac{5}{8} + \frac{1}{4} = ?$ $\frac{3}{8} - \frac{1}{4} = ?$ $\frac{7}{8} - \frac{1}{4} = ?$

*18. $\frac{3}{4} + \frac{1}{8} = ?$ $\frac{3}{4} + \frac{3}{8} = ?$ $\frac{3}{4} - \frac{1}{8} = ?$ $\frac{3}{4} - \frac{3}{8} = ?$ $\frac{7}{8} - \frac{3}{4} = ?$

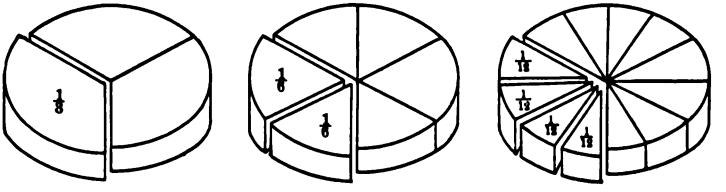
21. Changing Thirds, Sixths, and Twelfths to a Common Name

[Without pencil.]

1. Call the figures on the next page cakes. Into how many equal parts is each divided?

2. Name the smallest division in each cake.

3. These cakes are all the same size. If you were to take the smallest piece of cake, would you take $\frac{1}{3}$, $\frac{1}{6}$, or $\frac{1}{12}$ of a cake?



4. How many sixths of a cake equal $\frac{1}{3}$ of the cake? How many sixths equal $\frac{2}{3}$?

5. Find how many twelfths are equal to $\frac{1}{3}$. To $\frac{2}{3}$. To $\frac{1}{6}$. To $\frac{5}{6}$.

6. $1 = \frac{?}{6}$. $\frac{1}{3} = \frac{?}{6}$. $\frac{2}{3} = \frac{?}{6}$

7. $1 = \frac{?}{12}$. $\frac{1}{3} = \frac{?}{12}$. $\frac{2}{3} = \frac{?}{12}$.

8. $\frac{1}{6} = \frac{?}{12}$. $\frac{5}{6} = \frac{?}{12}$. $\frac{2}{6} = \frac{?}{3}$.

9. $\frac{4}{6} = ?$ $\frac{2}{12} = ?$ $\frac{4}{12} = ?$

10. What part equals the sum of $\frac{1}{6}$ and $\frac{1}{6}$? Of $\frac{1}{12}$ and $\frac{1}{12}$?

11. What part of a cake is left when, from $\frac{5}{6}$ of it, a part equal to $\frac{1}{6}$ of the cake is taken away?

12. From a cake cut into twelfths, $\frac{1}{3}$ is eaten. Find the number of twelfths left.

13. From a cake cut into twelfths, $\frac{1}{3}$ of the cake is taken and then $\frac{1}{2}$ of the cake. How many pieces are left?

14. What part of a circle is left when, from $\frac{5}{12}$ of it, one of the twelfths is taken away? (Show by drawing.)

15. Find out other facts about thirds, sixths, and twelfths.

16. $\frac{1}{6} + \frac{1}{6} = ?$ 20. $\frac{5}{6} + \frac{1}{6} = ?$ 24. $\frac{5}{6} - \frac{1}{6} = ?$ 28. $1 - \frac{1}{6} = ?$

17. $\frac{1}{12} + \frac{1}{12} = ?$ 21. $\frac{7}{12} + \frac{1}{12} = ?$ 25. $\frac{7}{12} - \frac{1}{12} = ?$ 29. $1 - \frac{5}{12} = ?$

18. $\frac{5}{12} + \frac{1}{12} = ?$ 22. $\frac{11}{12} + \frac{1}{12} = ?$ 26. $\frac{11}{12} - \frac{5}{12} = ?$ 30. $2 - \frac{1}{12} = ?$

19. $\frac{1}{3} + \frac{1}{6} = ?$ 23. $\frac{1}{3} + \frac{1}{12} = ?$ 27. $\frac{1}{3} - \frac{1}{12} = ?$ 31. $\frac{1}{6} + \frac{1}{12} = ?$

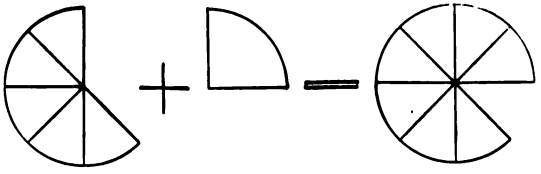
Classes needing further concrete experience with fractions may be given problems, similar to those above, based on drawings showing the relation of halves and thirds to sixths and of thirds and fourths to twelfths.

22. Review

I

[Use pencil for drawings only.]

$\frac{5}{8} + \frac{1}{4} = ?$



$\frac{5}{8} + \frac{1}{4} = \frac{7}{8}$

Make drawings illustrating these sums and differences:

1. $\frac{1}{2} + \frac{1}{4}$.
2. $\frac{1}{2} + \frac{1}{8}$.
3. $\frac{1}{2} + \frac{3}{8}$.
4. $\frac{1}{3} + \frac{1}{6}$.
5. $\frac{1}{2} - \frac{1}{4}$.
6. $\frac{3}{4} - \frac{1}{2}$.
7. $\frac{7}{8} - \frac{1}{4}$.
8. $\frac{5}{6} - \frac{1}{3}$.

Find these sums and differences without the help of drawings:

9. $\frac{1}{4} + \frac{1}{4}$.
10. $\frac{1}{6} + \frac{1}{6}$.
11. $\frac{3}{8} + \frac{1}{8}$.
12. $\frac{5}{8} + \frac{1}{8}$.
13. $\frac{5}{6} + \frac{1}{6}$.
14. $\frac{1}{4} + \frac{1}{8}$.
15. $\frac{3}{8} + \frac{1}{4}$.
16. $\frac{1}{2} + \frac{1}{6}$.
17. $\frac{3}{4} - \frac{1}{4}$.
18. $\frac{5}{6} - \frac{1}{6}$.
19. $\frac{5}{8} - \frac{3}{8}$.
20. $\frac{7}{8} - \frac{3}{8}$
*21. $\frac{5}{6} + \frac{3}{4}$.
*22. $\frac{7}{8} + \frac{3}{4} + \frac{1}{2}$.
*23. $1\frac{1}{2} - \frac{3}{4}$.
*24. $4\frac{5}{12} - 2\frac{1}{3}$.

II

[Without pencil.]

1. A birthday supper is to be planned. Allowing $\frac{1}{6}$ of a quart of ice-cream for each child, how many quarts must be ordered for 12 children?

2. If a mixture of cookies is wanted containing $1\frac{1}{2}$ pounds of cocoanut cookies, $\frac{1}{4}$ pound of nabiscos, and $\frac{1}{4}$ pound of macaroons, how many pounds must be bought?

3. How many pounds of candy must be purchased to have $\frac{3}{4}$ of

a pound of chocolates, $\frac{1}{2}$ pound of wintergreen patties, and $1\frac{1}{4}$ pounds of mixed candies?

4. How many half-sandwiches can be made from 6 sandwiches? From 12?

5. If a chocolate cake is cut into eighths and a nut cake into twelfths, how many pieces will there be altogether?

6. How many pieces will there be in two cakes, if you cut one into tenths and the other into sixteenths?

*7. Chocolate is to be served. How many quarts must be made for 12 children in order to have 1 cupful ($\frac{1}{2}$ pint) for each child?

23. The Terms of a Fraction

1. Write the fraction that stands for the shaded portion of a circle divided into 4 equal parts with 3 of the parts shaded.

2. Write the fraction that stands for the shaded portion of a square divided into 8 equal parts with 5 of the parts shaded.

3. Tell how to represent each of the following fractions by a drawing: [1]

$$\frac{2}{3} \qquad \frac{5}{6} \qquad \frac{7}{8} \qquad \frac{3}{16}$$

4. Which numbers in the fractions above show the number of parts into which the unit is divided? Which show how many of the equal parts are taken to form the fraction?

The number that shows into how many equal parts a unit is divided is called the **denominator** (namer) of the fraction.

In the fractions $\frac{2}{3}$, $\frac{5}{6}$, $\frac{7}{8}$, and $\frac{3}{16}$, the numbers 3, 6, 8, and 16 are the denominators.

[1] Drawings should be profusely used in teaching fractions as long as children are in the stage when they are building concepts. It should be kept in mind, however, that drawings are a means to an end and not an end in themselves. After the work has progressed to the point of understanding, objective work is a hindrance rather than a help.

The number that shows how many equal parts form the fraction is called the **numerator** (numberer) of the fraction.

In the fractions $\frac{2}{8}$, $\frac{5}{8}$, $\frac{7}{8}$, and $\frac{3}{16}$, the numbers 2, 5, 7, and 3 are the numerators.

The numerator and the denominator of a fraction are called the **terms** of the fraction.

In the fraction $\frac{7}{8}$, 7 and 8 are the terms of the fraction. The number 8 shows that the unit is divided into 8 equal parts; it is, therefore, the denominator of the fraction. The number 7 shows that 7 of the 8 equal parts have been taken to form the fraction; it is, therefore, the numerator of the fraction.

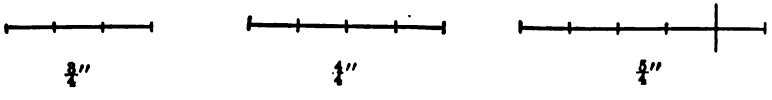
Name the terms of these fractions and tell what each shows:

5. $\frac{1}{3}$, $\frac{3}{4}$, $\frac{1}{6}$.
6. $\frac{1}{5}$, $\frac{4}{5}$, $\frac{3}{7}$.
7. $\frac{5}{8}$, $\frac{3}{10}$, $\frac{5}{12}$.
8. $\frac{6}{9}$, $\frac{4}{11}$, $\frac{2}{15}$.
9. $\frac{5}{16}$, $\frac{4}{25}$, $\frac{2}{75}$.
10. $\frac{3}{20}$, $\frac{1}{50}$, $\frac{7}{100}$.

24. Proper and Improper Fractions

[Without pencil.]

1. Which of the following fractions stands for an inch? For less than an inch? For more than an inch?



2. Which of the following fractions stand for one unit? Which for less than a unit? Which for more than a unit?

$\frac{1}{2}$, $\frac{3}{2}$, $\frac{2}{8}$, $\frac{8}{2}$, $\frac{3}{4}$, $\frac{4}{3}$, $\frac{4}{4}$, $\frac{5}{8}$, $\frac{11}{12}$, $\frac{13}{12}$.

Since the word fraction is commonly taken to mean a part, all fractions that equal less than one are called **proper fractions**, and all those that equal one or more than one are called **improper fractions**.

A proper fraction is less than a unit.

$\frac{1}{4}$, $\frac{5}{8}$, $\frac{3}{7}$, $\frac{2}{3}$, and $\frac{5}{12}$ are proper fractions.

An improper fraction is equal to a unit or more than a unit.

$\frac{3}{2}$, $\frac{8}{2}$, $\frac{4}{3}$, $\frac{4}{4}$, and $\frac{13}{12}$ are improper fractions.

3. Which kind of fraction has a numerator smaller than its denominator? Which kind has a numerator equal to or larger than its denominator?

Classify as proper or improper fractions:

4. $\frac{3}{4}$, $\frac{5}{3}$, $\frac{9}{4}$.
5. $\frac{3}{8}$, $\frac{3}{16}$, $\frac{7}{12}$.
6. $\frac{5}{8}$, $\frac{3}{5}$, $\frac{8}{5}$.
7. $\frac{5}{8}$, $\frac{8}{3}$, $\frac{17}{16}$.
8. $\frac{1}{5}$, $\frac{1}{3}$, $\frac{7}{7}$.
9. $\frac{1}{5}$, $\frac{8}{3}$, $\frac{8}{7}$.
10. $\frac{7}{4}$, $\frac{10}{10}$, $\frac{12}{3}$.
11. $\frac{8}{9}$, $\frac{11}{15}$, $\frac{18}{16}$.
12. $\frac{8}{8}$, $\frac{11}{11}$, $\frac{15}{5}$.

An integer is a whole number.

9, 11, 25, 247, and 1000 are integers.

A mixed number is an integer and a fraction written together.

$5\frac{1}{3}$, $17\frac{3}{8}$, $45\frac{11}{12}$, and $107\frac{1}{4}$ are mixed numbers.

Classify each of the following as a proper fraction, an improper fraction, an integer, or a mixed number: [1]

1. 12, $14\frac{3}{8}$, $16\frac{1}{2}$.
2. 204, $412\frac{1}{3}$, 618.
3. 420, $8\frac{3}{4}$, $49\frac{7}{8}$.
4. $\frac{3}{10}$, $2\frac{5}{8}$, $\frac{4}{3}$.
5. $\frac{5}{8}$, $\frac{12}{5}$, $\frac{30}{3}$.
6. 14, 217, $149\frac{1}{6}$.
7. $\frac{12}{7}$, $\frac{8}{6}$, $\frac{18}{16}$.
8. $\frac{11}{12}$, $\frac{8}{3}$, $4\frac{7}{8}$.
9. 97, $\frac{7}{7}$, $214\frac{3}{8}$.

25. Reduction to Lower and Higher Terms

I

[Without pencil.]

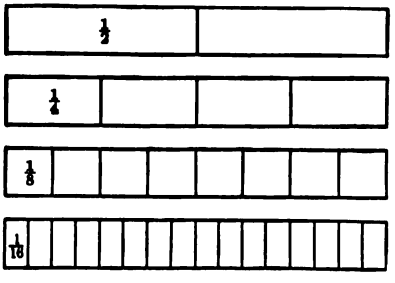
1. Multiply by 2 both the numerator and the denominator in the fraction $\frac{1}{2}$. What is the answer?

[1] In mastering this classification, the following game will be found helpful. With the help of a rubber pen or its substitute, a sharpened eraser on the end of a pencil, numbers similar to those above are written on cards about four inches square. These cards are held before the class and flashed one at a time. As each card is displayed, the teacher names the child who is to classify the number as a proper fraction, an improper fraction, an integer, or a mixed number. If a child fails in his classification, he must stand by his seat until he can give the correct answer when another child fails. When he has given a correct answer, he takes his seat.

If a teacher prefers, the numbers may be written on the board one at a time instead of being shown on cards.

2. Multiply by 4 both the numerator and the denominator in the fraction $\frac{1}{2}$. What is the answer?

3. Which is larger, $\frac{1}{2}$ or $\frac{3}{4}$? $\frac{1}{4}$ or $\frac{4}{16}$? (See diagram.)



4. Compare $\frac{1}{2}$ with $\frac{1 \times 2}{2 \times 2}$. Which has the greater value?

5. Compare $\frac{1}{4}$ with $\frac{1 \times 4}{4 \times 4}$.

6. Which has the greater value, $\frac{1}{2}$ or $\frac{1 \times 8}{2 \times 8}$? $\frac{3}{4}$ or $\frac{3 \times 2}{4 \times 2}$? $\frac{3}{4}$ or $\frac{3 \times 4}{4 \times 4}$?

7. What is the effect on the value of a fraction, of multiplying both terms by the same number?

8. Find, in the diagram above, the number of halves that equal $\frac{4}{8}$. Find the number of eighths that equal $\frac{12}{16}$.

9. Compare $\frac{4}{8}$ with $\frac{4 + 4}{8 + 4}$ or $\frac{1}{2}$. Which has the greater value?

10. Compare $\frac{12}{16}$ with $\frac{10 + 2}{16 + 2}$ or $\frac{5}{8}$.

11. What is the effect on the value of a fraction, of dividing both terms by the same number?

From the facts learned above, it can be seen that the following is true:

Both terms of a fraction may be multiplied or divided by the same number without changing the value of the fraction.

The process of changing the terms of a fraction without changing its value is called **reduction.**

II

[Use pencil only when needed.]

1. How do these fractions compare in value: $\frac{4}{8}$ and $\frac{1}{2}$? $\frac{8}{9}$ and $\frac{1}{3}$?

2. Which fraction has the smaller numbers as terms: $\frac{4}{8}$ or $\frac{1}{2}$? $\frac{8}{9}$ or $\frac{1}{3}$?

When the terms of a fraction are changed to smaller numbers without changing the value of the fraction, the fraction is reduced to **lower terms.**

To reduce a fraction to lower terms, divide both its numerator and its denominator by the same number.

A fraction is in its **lowest terms** when its terms are divisible by no number greater than one.

$\frac{1}{3}$, $\frac{3}{7}$, $\frac{2}{5}$, $\frac{5}{11}$, and $\frac{4}{25}$ are in their lowest terms.

Which of the following fractions are in their lowest terms? Reduce those that are not in their lowest terms:

3. $\frac{1}{3}$	7. $\frac{4}{14}$	11. $\frac{5}{20}$	15. $\frac{6}{8}$	19. $\frac{8}{10}$	23. $\frac{40}{50}$
4. $\frac{6}{12}$	8. $\frac{9}{12}$	12. $\frac{4}{8}$	16. $\frac{3}{11}$	20. $\frac{8}{16}$	24. $\frac{5}{8}$
5. $\frac{7}{15}$	9. $\frac{3}{4}$	13. $\frac{3}{17}$	17. $\frac{44}{55}$	21. $\frac{3}{9}$	25. $\frac{60}{120}$
6. $\frac{10}{15}$	10. $\frac{1}{6}$	14. $\frac{1}{2}$	18. $\frac{8}{5}$	22. $\frac{8}{32}$	26. $\frac{480}{500}$

27. Divide 326 by 4. Reduce the fraction in the quotient to its lowest terms.

In solving the following problems, reduce each fraction to its lowest terms before placing it in the quotient:

28. 746 ÷ 6 = ?	31. 2094 ÷ 9 = ?	34. 4711 ÷ 42 = ?
29. 342 ÷ 8 = ?	32. 298 ÷ 12 = ?	35. 3110 ÷ 25 = ?
30. 728 ÷ 10 = ?	33. 522 ÷ 24 = ?	36. 16,076 ÷ 32 = ?

III

1. Which fraction has the larger numbers as terms, $\frac{1}{2}$ or $\frac{8}{16}$? $\frac{1}{3}$ or $\frac{3}{9}$?

When the terms of a fraction are changed to larger numbers, the fraction is raised to **higher terms.**

To raise a fraction to higher terms, multiply both its terms by the same number.

[Without pencil.]

Complete:

2. $\frac{1}{3} = \frac{?}{9}$
3. $\frac{2}{3} = \frac{?}{9}$
4. $\frac{1}{5} = \frac{?}{15}$
5. $\frac{3}{5} = \frac{?}{15}$
6. $\frac{1}{8} = \frac{?}{16}$
7. $\frac{7}{8} = \frac{?}{16}$
8. $\frac{1}{4} = \frac{?}{12}$
9. $\frac{3}{4} = \frac{?}{12}$
10. $\frac{1}{3} = \frac{?}{12}$
11. $\frac{2}{3} = \frac{?}{12}$
12. $\frac{3}{4} = \frac{?}{16}$
13. $\frac{3}{4} = \frac{?}{16}$

26. Reduction of an Improper Fraction

How many inches are there in $\frac{10}{2}$ inches? In $\frac{15}{4}$ inches?

$\frac{10}{2}$ inches = ?
$\frac{2}{2} = 1$ inch. In $\frac{10}{2}$ inches, there are as many inches as $\frac{2}{2}$ is contained in $\frac{10}{2}$.
$\frac{10}{2} \div \frac{2}{2} = 5$. $\frac{10}{2}$ inches = 5 inches.

$\frac{15}{4}$ inches = ?
$\frac{4}{4} = 1$ inch. In $\frac{15}{4}$ inches, there are as many inches as $\frac{4}{4}$ is contained in $\frac{15}{4}$.
$\frac{15}{4} \div \frac{4}{4} = 3\frac{3}{4}$. $\frac{15}{4}$ inches = $3\frac{3}{4}$ inches.

Notice that $\frac{10}{2} \div \frac{2}{2} = 10 \div 2$ and that $\frac{15}{4} \div \frac{4}{4} = 15 \div 4$. In both problems above, the number of inches could have been found by dividing the numerator of each fraction by its denominator.

To reduce an improper fraction to an integer or a mixed number, divide the numerator by the denominator.

[Without pencil.]

Reduce to whole or mixed numbers:

1. $\frac{6}{2}$, $\frac{6}{3}$, $\frac{8}{4}$.
2. $\frac{7}{2}$, $\frac{9}{4}$, $\frac{11}{3}$.
3. $\frac{16}{4}$, $\frac{17}{3}$, $\frac{36}{12}$.
4. $\frac{40}{5}$, $\frac{21}{4}$, $\frac{13}{3}$.
5. $\frac{10}{4}$, $\frac{17}{2}$, $\frac{37}{4}$.
6. $\frac{55}{11}$, $\frac{48}{7}$, $\frac{64}{8}$.
7. $\frac{12}{9}$, $\frac{16}{5}$, $\frac{24}{8}$.
8. $\frac{40}{5}$, $\frac{38}{4}$, $\frac{10}{3}$.
9. $\frac{17}{3}$, $\frac{20}{3}$, $\frac{38}{6}$.
10. $\frac{14}{4}$, $\frac{21}{6}$, $\frac{60}{12}$.
11. $\frac{72}{9}$, $\frac{34}{9}$, $\frac{45}{5}$.
12. $\frac{35}{9}$, $\frac{39}{3}$, $\frac{76}{8}$.

27. Reduction of Mixed Numbers

[Without pencil.]

How many quarters of a yard are there in $2\frac{3}{4}$ yards?

In 1 yard there are $\frac{4}{4}$. In $2\frac{3}{4}$ (2 and $\frac{3}{4}$) yards there are $2 \times \frac{4}{4} + \frac{3}{4}$. $2 \times \frac{4}{4} = \frac{8}{4}$. $\frac{8}{4} + \frac{3}{4} = \frac{11}{4}$. $2\frac{3}{4}$ yd. = $\frac{11}{4}$ yd.

1. How many eighths of an inch are there in $1\frac{1}{8}$ inches? Explain.
2. How many half hours are there in $3\frac{1}{2}$ hours? Explain.

3. How many thirds of an apple in $4\frac{2}{3}$ apples? Explain.

It will be noticed that the answer for each of the last four problems could have been found by multiplying the integer by the denominator of the fraction, adding the numerator to their product, and placing the result over the denominator.

To reduce a mixed number to an improper fraction, multiply the integer by the denominator of the fraction, add the numerator to the product, and place the result over the denominator.

Reduce to improper fractions:

4. $1\frac{1}{2}$, $1\frac{1}{3}$, $2\frac{1}{2}$.
5. $3\frac{1}{3}$, $2\frac{1}{3}$, $4\frac{1}{4}$.
6. $1\frac{4}{7}$, $3\frac{3}{4}$, $2\frac{3}{8}$.
7. $4\frac{5}{8}$, $3\frac{5}{6}$, $6\frac{3}{7}$.
8. $9\frac{1}{3}$, $11\frac{1}{7}$, $8\frac{1}{6}$.
9. $4\frac{3}{5}$, $5\frac{3}{8}$, $9\frac{3}{8}$.
10. $10\frac{1}{4}$, $14\frac{1}{2}$, $8\frac{7}{8}$.
11. $2\frac{1}{12}$, $11\frac{3}{8}$, $12\frac{1}{4}$.
*12. $15\frac{3}{5}$, $40\frac{1}{8}$, $25\frac{3}{8}$.

28. Review [1]

[Without pencil.]

1. Classify each of the following as a proper fraction, as an improper fraction, or as a mixed number:

$\frac{3}{4}$, $\frac{4}{3}$, $\frac{5}{5}$, $2\frac{1}{2}$, $25\frac{1}{4}$, $\frac{8}{5}$, $\frac{13}{12}$, $\frac{5}{16}$, $14\frac{3}{4}$, $\frac{7}{5}$.

Reduce to lowest terms:

2. $\frac{3}{6}$, $\frac{4}{6}$, $\frac{9}{12}$.
3. $\frac{5}{15}$, $\frac{7}{35}$, $\frac{16}{20}$.
4. $\frac{4}{8}$, $\frac{10}{24}$, $\frac{12}{18}$.
5. $\frac{14}{21}$, $\frac{11}{44}$, $\frac{12}{15}$.
6. $\frac{17}{36}$, $\frac{32}{48}$, $\frac{13}{24}$.
*7. $\frac{15}{120}$, $\frac{168}{288}$, $\frac{16}{36}$.

Reduce to whole or mixed numbers:

8. $\frac{18}{2}$, $\frac{21}{4}$, $\frac{15}{3}$.
9. $\frac{11}{3}$, $\frac{23}{3}$, $\frac{45}{9}$.
10. $\frac{24}{7}$, $\frac{19}{8}$, $\frac{35}{8}$.
11. $\frac{63}{7}$, $\frac{81}{4}$, $\frac{50}{2}$.
12. $\frac{24}{3}$, $\frac{29}{7}$, $\frac{40}{4}$.
*13. $\frac{116}{9}$, $\frac{462}{4}$, $\frac{875}{7}$.

Reduce to improper fractions:

14. $3\frac{1}{4}$, $2\frac{1}{7}$, $1\frac{1}{8}$.
15. $5\frac{3}{8}$, $4\frac{3}{7}$, $3\frac{5}{8}$.
16. $2\frac{1}{3}$, $6\frac{3}{8}$, $11\frac{1}{2}$.
17. $9\frac{3}{8}$, $7\frac{5}{8}$, $5\frac{3}{8}$.
18. $6\frac{3}{7}$, $8\frac{1}{4}$, $3\frac{1}{9}$.
*19. $12\frac{3}{8}$, $14\frac{1}{4}$, $16\frac{3}{4}$.

[1] In this work it will be found helpful to give daily practice, using fraction cards covering all the forms of reduction. See footnote, page 41.

29. Progress Score

Try, within a limit of 15 minutes, to make a score of 100 points in this exercise, counting for each correct answer the score given in parenthesis below the letter of the problem.

[Copy problems only when necessary.]

I. Add:

A. (4) 327 / 245 / 675 / 809 / 678

B. (5) $24.75 / 36.82 / 9.76 / 38.24 / 16.75

C. $\frac{3}{4} + \frac{1}{4}$. (3)

D. $\frac{3}{8} + \frac{1}{8}$. (3)

E. $\frac{2}{3} + \frac{2}{3}$. (4)

F. $\frac{1}{6} + \frac{1}{3}$. (5)

II. Subtract:

G. (3) 7423 / 2189

H. (4) $14.00 / 2.24

I. $\frac{5}{8} - \frac{1}{8}$. (4)

J. $\frac{5}{6} - \frac{1}{3}$. (5)

III. Multiply:

K. (4) 9607 × 8

L. (6) 1427 × 49

M. (7) $4.25 × 307

IV. Divide:

N. (7) 9)78687

O. (10) 64)$204.80

P. (11) 573)21774

V. Reduce:

Q. To lowest terms:[1] $\frac{4}{6}$, $\frac{3}{9}$, $\frac{8}{12}$, $\frac{12}{16}$, $\frac{30}{28}$. (5)

R. To whole or mixed numbers:[1] $\frac{8}{4}$, $\frac{10}{3}$, $\frac{12}{3}$, $\frac{15}{2}$, $\frac{16}{5}$. (5)

S. To improper fractions:[1] $1\frac{1}{2}$, $2\frac{3}{8}$, $5\frac{1}{4}$, $3\frac{5}{8}$, $2\frac{1}{12}$. (5)

[1] Count 1 for each correct answer.

CHAPTER III. OUTDOOR SPORTS

30. Athletic Records

[Without pencil.]

1. Every year, mile records are taken of the time required by men and boys in running, walking, rowing, swimming, and skating. In which kind of race do you think a mile has been covered in the least time?

2. Read the following records in order of the time taken, putting the sport first in which a mile has been covered in the least time:

ONE MILE RECORDS

Running	4 min.	15 sec.
Running (Relay with 5 men)	3 "	17 "
Walking	6 "	30 "
Swimming	23 "	17 "
Rowing	6 "	5 "
Skating	2 "	36 "

3. In a boys' swimming contest, the winner swam fifty yards in 30 seconds. What part of a minute did he take?

4. In a boys' half-mile relay race (4 boys), a record of 1 minute 45 seconds has been made. Express the record in minutes.

5. Express in minutes the first record in running given on page 47; also, the record in walking.

6. What part of a foot is 6 in.? 3 in.? 9 in.?

7. Express in feet a record of 4 ft. 6 in. for a running high jump. Of 16 ft. 9 in. for a running broad jump.

31. Addition of Like Fractions

I

John is training for a rowing contest. Every morning he rows $\frac{3}{8}$ of a mile across a lake and then takes a course $\frac{7}{8}$ of a mile long that brings him back to his starting point. What is the distance covered in his morning row?

$\frac{3}{8}$ mi. + $\frac{7}{8}$ mi. = ?

$\frac{3}{8} + \frac{7}{8} = \frac{10}{8}$. $\frac{10}{8} = 1\frac{2}{8}$, or $1\frac{1}{4}$.

The distance covered is $1\frac{1}{4}$ miles.

Notice that the denominators in the two fractions $\frac{3}{8}$ and $\frac{7}{8}$ are the same. The fractions are, therefore, called **like fractions.** Fractions that have different denominators are called **unlike fractions.**

$\frac{5}{16}$, $\frac{3}{16}$, $\frac{11}{16}$, are like fractions. $\frac{1}{4}$, $\frac{1}{8}$, and $\frac{1}{2}$ are unlike fractions.

To add like fractions add the numerators, place the result over the denominator, and reduce if necessary.

[Without pencil.]

1. What is the sum of $\frac{5}{16}$ and $\frac{3}{16}$? Of $\frac{5}{7}$ and $\frac{6}{7}$? Of $\frac{8}{11}$ and $\frac{5}{11}$?

2. To reach the football grounds belonging to his school, Frank must ride $\frac{3}{4}$ of a mile on a trolley car and then walk $\frac{3}{4}$ of a mile. How far must he travel?

3. The sails of a boat are to be mended. One sail requires $\frac{7}{8}$ of a yard of canvas; the other sail, $\frac{5}{8}$ of a yard. How many yards are needed for the two sails?

Complete:

4. $\frac{1}{3} + \frac{2}{3} = ?$
5. $\frac{3}{8} + \frac{4}{8} = ?$
6. $\frac{5}{12} + \frac{7}{12} = ?$
7. $\frac{7}{8} + \frac{7}{8} = ?$
8. $\frac{7}{10} + \frac{8}{10} = ?$
9. $\frac{6}{7} + \frac{4}{7} = ?$
10. $\frac{3}{4} + \frac{3}{4} + \frac{1}{4} = ?$
11. $\frac{5}{8} + \frac{5}{8} + \frac{1}{8} = ?$
12. $\frac{11}{16} + \frac{7}{16} + \frac{5}{16} + \frac{5}{16} = ?$

II

Two knapsacks are to be made. One requires $1\frac{3}{4}$ yards of cloth; the other, $2\frac{3}{4}$ yards. How many yards are required for the two?

$1\frac{3}{4}$ yd. + $2\frac{3}{4}$ yd. = ?

$1\frac{3}{4}$	The sum of the fractions equals $\frac{3}{4} + \frac{3}{4}$, or $\frac{6}{4}$. $\frac{6}{4} = 1\frac{1}{2}$.
$2\frac{3}{4}$	The sum of the integers equals $2 + 1$, or 3.
$\frac{6}{4} = 1\frac{1}{2}$	The sum of the integers and fractions equals $3 + 1\frac{1}{2}$, or $4\frac{1}{2}$.
$3 + 1\frac{1}{2} = 4\frac{1}{2}$	The amount of cloth required is $4\frac{1}{2}$ yards.

[Use pencil only when needed.]

1. Give directions for adding mixed numbers that contain like fractions.

2. What is the sum of $4\frac{3}{8}$ and $8\frac{3}{8}$? Of $6\frac{6}{7}$ and $8\frac{1}{7}$? Of $14\frac{7}{8}$ and $8\frac{1}{8}$?

3. In buying camp supplies, Henry buys $2\frac{1}{2}$ lb. of coffee, $4\frac{1}{2}$ lb. of butter, and $8\frac{1}{2}$ lb. of sugar. What is the weight of the supplies?

4. Going to camp, Tom had to carry one package weighing $14\frac{3}{4}$ pounds, and one weighing $4\frac{3}{4}$ pounds. How much did both weigh?

5. Fred and his brother rowed a boat down a river. The first hour they rowed $6\frac{7}{8}$ miles; the second hour, $5\frac{3}{8}$ miles; and the third hour, $5\frac{7}{8}$ miles. What was the distance covered?

Find the value of:

6. $12\frac{3}{4} + \frac{1}{4}$.
7. $4\frac{3}{8} + \frac{5}{8}$.
8. $7\frac{1}{8} + \frac{5}{8}$.
9. $5\frac{1}{16} + \frac{5}{16}$.
10. $2\frac{5}{12} + 3\frac{1}{12}$.
11. $8\frac{5}{7} + 4\frac{2}{7}$.
12. $9\frac{3}{4} + 8\frac{3}{4}$.
13. $6\frac{7}{8} + 3\frac{7}{8}$.
14. $2\frac{1}{7} + 4\frac{3}{7} + 3\frac{5}{7}$.
15. $9\frac{1}{8} + 3\frac{5}{8} + 4\frac{3}{8}$.
16. $24\frac{5}{12} + 12\frac{7}{12} + 32\frac{5}{12}$.
17. $40\frac{11}{16} + 25\frac{5}{16} + 8\frac{7}{16}$.

32. Subtraction of Like Fractions

I

How much wider is a lake that is $\frac{7}{8}$ of a mile in width than one that is $\frac{3}{8}$ of a mile in width?

$\frac{7}{8}$ mi. $-$ $\frac{3}{8}$ mi. $=$?

$\frac{7}{8} - \frac{3}{8} = \frac{4}{8}$, or $\frac{1}{2}$.

The difference in the width of the lakes is $\frac{1}{2}$ mile.

To subtract like fractions, subtract the numerators, place the result over the denominator, and reduce if necessary.

[Without pencil.]

1. Find the difference between $\frac{5}{7}$ and $\frac{2}{7}$. Between $\frac{11}{12}$ and $\frac{7}{12}$. Between $\frac{11}{16}$ and $\frac{3}{16}$.

2. $\frac{4}{5} - \frac{2}{5} = ?$
3. $\frac{5}{9} - \frac{2}{9} = ?$
4. $\frac{5}{11} - \frac{3}{11} = ?$
5. $\frac{9}{10} - \frac{3}{10} = ?$
6. $\frac{11}{12} - \frac{5}{12} = ?$
7. $\frac{7}{8} - \frac{5}{8} = ?$
8. $\frac{5}{6} - \frac{1}{6} = ?$
9. $\frac{7}{16} - \frac{3}{16} = ?$
10. $\frac{15}{16} - \frac{3}{16} = ?$
11. $\frac{11}{14} - \frac{3}{14} = ?$
12. $\frac{11}{15} - \frac{4}{15} = ?$
13. $\frac{7}{24} - \frac{1}{24} = ?$

II

How much is left from a coil of wire containing $60\frac{2}{3}$ yards after $24\frac{1}{3}$ yards have been used?

$60\frac{2}{3}$ yd. $-$ $24\frac{1}{3}$ yd. $=$?

$$\begin{array}{r} 60\frac{2}{3} \\ 24\frac{1}{3} \\ \hline 36\frac{1}{3} \end{array}$$

The difference between the fractions is $\frac{2}{3} - \frac{1}{3}$, or $\frac{1}{3}$.
The difference between the integers is $60 - 24$, or 36.
The total difference equals $36 + \frac{1}{3}$, or $36\frac{1}{3}$.
The number of yards left in the coil of wire is $36\frac{1}{3}$ yards.

[Use pencil only when needed.]

1. Give directions for subtracting mixed numbers that contain like fractions.

2. Subtract: $4\frac{2}{7}$ from $8\frac{5}{7}$; $5\frac{11}{12}$ from $9\frac{5}{12}$; $12\frac{1}{6}$ from $18\frac{5}{6}$.

3. In making a bow for arrows, Tom cut a piece of wood $4\frac{1}{2}$ inches long from a strip $40\frac{1}{2}$ inches long, and used the piece left for the bow. How long did he make his bow?

4. Tom made one arrow $24\frac{3}{4}$ inches long, and another $21\frac{1}{4}$ inches long. What was the difference in their lengths?

5. Fred bought $1\frac{7}{8}$ yards of muslin for the sails of a toy airship and used $1\frac{5}{8}$ yards. What was the length of the piece left?

6. $5\frac{6}{7} - \frac{3}{7} = ?$	10. $14\frac{8}{11} - 5\frac{8}{11} = ?$	14. $8\frac{7}{12} - 3\frac{1}{12} = ?$
7. $2\frac{5}{6} - \frac{1}{6} = ?$	11. $2\frac{7}{8} - 1\frac{3}{8} = ?$	15. $40\frac{11}{15} - 32\frac{8}{15} = ?$
8. $18\frac{11}{12} - \frac{5}{12} = ?$	12. $8\frac{5}{6} - 3\frac{1}{6} = ?$	16. $72\frac{11}{24} - 50\frac{5}{24} = ?$
9. $8\frac{4}{5} - 3\frac{3}{5} = ?$	13. $12\frac{7}{16} - 5\frac{3}{16} = ?$	17. $86\frac{15}{16} - 38\frac{7}{16} = ?$

*18. From the sum of $114\frac{3}{8}$ and $42\frac{7}{8}$, subtract $75\frac{1}{8}$.

*19. To the difference between $24\frac{7}{16}$ and $18\frac{1}{16}$, add $36\frac{5}{16}$.

33. Finding a Common Denominator

I

[Without pencil.]

In order to add $\frac{1}{2}$ and $\frac{1}{4}$, one half, as you learned on page 36, is changed to fourths. $\frac{1}{2} = \frac{2}{4}$. The sum of the fractions is, therefore, the sum of $\frac{2}{4}$ and $\frac{1}{4}$, or $\frac{3}{4}$.

When the same denominator is given to two or more fractions, they are said to have a **common denominator.**

4 is a common denominator for fourths and halves.

1. What number can be used as a common denominator for $\frac{1}{4}$ and $\frac{1}{8}$? For $\frac{1}{6}$ and $\frac{1}{3}$? For $\frac{1}{12}$ and $\frac{1}{3}$?

2. What is the smallest number that can be divided by both 4 and 5 without a remainder? What is the smallest number that can be used as a common denominator for $\frac{1}{4}$ and $\frac{1}{5}$?

The smallest number that can be used as a common denominator of two or more fractions is called their **least common denominator.**

The least common denominator of $\frac{1}{2}$ and $\frac{1}{3}$ is 6; of $\frac{1}{3}$ and $\frac{1}{9}$ is 9; of $\frac{1}{4}$ and $\frac{1}{3}$ is 12; of $\frac{1}{4}$ and $\frac{1}{5}$ is 20.

To find the least common denominator of two or more fractions, find the smallest number that is exactly divisible by their denominators.

Find the least common denominator of:[1]

3. $\frac{1}{4}$ and $\frac{1}{8}$.
4. $\frac{1}{8}$ and $\frac{1}{5}$.
5. $\frac{1}{4}$ and $\frac{1}{5}$.
6. $\frac{1}{4}$ and $\frac{1}{6}$.
7. $\frac{1}{4}$ and $\frac{1}{6}$.
8. $\frac{1}{12}$ and $\frac{1}{8}$.
9. $\frac{1}{4}$ and $\frac{1}{5}$.
10. $\frac{1}{4}$ and $\frac{1}{6}$.
11. $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$.
12. $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{12}$.
*13. $\frac{1}{12}$, $\frac{1}{4}$, and $\frac{1}{12}$.
*14. $\frac{1}{12}$, $\frac{1}{18}$, and $\frac{1}{9}$.

II

Change $\frac{1}{4}$ and $\frac{1}{6}$ to the least common denominator.

Since 12 is the smallest number that can be divided by both 4 and 6 without a remainder, 12 is used as the least common denominator.

By what number is it necessary to multiply both terms to change $\frac{1}{4}$ to twenty-fourths? To change $\frac{1}{6}$ to twenty-fourths? How is each number found?

$\frac{1}{4} = \frac{}{24}$	$\frac{1}{6} = \frac{}{24}$
Think $\frac{1}{4} = \frac{1 \times 6}{4 \times 6} = \frac{6}{24}$	Think $\frac{1}{6} = \frac{1 \times 4}{6 \times 4} = \frac{4}{24}$
Write $\frac{1}{4} = \frac{6}{24}$	Write $\frac{1}{6} = \frac{4}{24}$

[Use pencil only when needed.]

1. In changing $\frac{1}{4}$ to twelfths by what number is it necessary to multiply both terms?

2. Tell how to change $\frac{1}{5}$ and $\frac{1}{6}$ to fifteenths, $\frac{1}{4}$ and $\frac{1}{6}$ to twenty-fourths, $\frac{1}{3}$ and $\frac{1}{5}$ to thirtieths.

3. Change to a common denominator the fractions in each problem in the exercise in the text on this page.

When we have difficulty in finding the least common denominator of a group of fractions, some of the larger numbers may be denominators and yet not be the smallest number exactly divisible by the other denominators. In finding the least common denominator of 4, 6, and 12, the 12 is the smallest number exactly divisible by 4 and 6, but it is not the least common denominator of $\frac{1}{4}$, $\frac{1}{6}$, and $\frac{1}{12}$.

34. Addition and Subtraction of Unlike Fractions

(1) What is a boy's swimming record for a day, if he swims $\frac{3}{4}$ of a mile in the morning and $\frac{5}{8}$ of a mile in the afternoon?

(2) What is the difference between the record made in the morning and the one made in the afternoon?

(1)

$\frac{3}{4}$ mi. + $\frac{5}{8}$ mi. = ?

$\frac{3}{4}$ | $\frac{6}{8}$

$\frac{5}{8}$ | $\frac{5}{8}$

$\frac{11}{8} = 1\frac{3}{8}$

Total distance = $1\frac{3}{8}$ miles.

(2)

$\frac{3}{4}$ mi. − $\frac{5}{8}$ mi. = ?

$\frac{3}{4}$ | $\frac{6}{8}$

$\frac{5}{8}$ | $\frac{5}{8}$

$\frac{1}{8}$

The difference = $\frac{1}{8}$ of a mile.

To add or subtract unlike fractions, first change them to a common denominator.

[Use pencil only when needed.]

1. Find the sum of $\frac{3}{8}$ and $\frac{3}{10}$. Of $\frac{3}{4}$ and $\frac{1}{3}$. Of $\frac{5}{8}$ and $\frac{1}{4}$.

2. Find the difference between $\frac{7}{8}$ and $\frac{1}{4}$. Between $\frac{3}{10}$ and $\frac{1}{2}$. Between $\frac{5}{8}$ and $\frac{1}{4}$.

3. In going to his favorite fishing pool, Tom traveled in his canoe $\frac{2}{3}$ of a mile on a lake and $\frac{3}{4}$ of a mile up a stream. How far did he travel?

4. Tom caught three trout. The first weighed $\frac{7}{8}$ of a pound; the second, $\frac{5}{6}$ of a pound; and the third, $\frac{3}{4}$ of a pound. How much did they weigh together?

5. Which trout weighed the most? How much more did it weigh than the smallest trout?

6. What is the difference in the weight of two fish when one weighs $\frac{7}{8}$ of a pound and the other $\frac{1}{2}$ pound.

[Without pencil.]

Complete:

2. $\frac{1}{3} = \frac{?}{9}$
3. $\frac{2}{3} = \frac{?}{9}$
4. $\frac{1}{5} = \frac{?}{15}$
5. $\frac{2}{5} = \frac{?}{15}$
6. $\frac{1}{8} = \frac{?}{16}$
7. $\frac{7}{8} = \frac{?}{16}$
8. $\frac{1}{4} = \frac{?}{12}$
9. $\frac{2}{4} = \frac{?}{12}$
10. $\frac{1}{2} = \frac{?}{14}$
11. $\frac{2}{3} = \frac{?}{12}$
12. $\frac{3}{7} = \frac{?}{14}$
13. $\frac{2}{4} = \frac{?}{16}$

26. Reduction of an Improper Fraction

How many inches are there in $\frac{10}{2}$ inches? In $\frac{15}{4}$ inches?

$\frac{10}{2}$ inches = ?
$\frac{2}{2}$ = 1 inch. In $\frac{10}{2}$ inches, there are as many inches as $\frac{2}{2}$ is contained in $\frac{10}{2}$.
$\frac{10}{2} \div \frac{2}{2} = 5$. $\frac{10}{2}$ inches = 5 inches.

$\frac{15}{4}$ inches = ?
$\frac{4}{4}$ = 1 inch. In $\frac{15}{4}$ inches, there are as many inches as $\frac{4}{4}$ is contained in $\frac{15}{4}$.
$\frac{15}{4} \div \frac{4}{4} = 3\frac{3}{4}$. $\frac{15}{4}$ inches = $3\frac{3}{4}$ inches.

Notice that $\frac{10}{2} \div \frac{2}{2} = 10 \div 2$ and that $\frac{15}{4} \div \frac{4}{4} = 15 \div 4$. In both problems above, the number of inches could have been found by dividing the numerator of each fraction by its denominator.

To reduce an improper fraction to an integer or a mixed number, divide the numerator by the denominator.

[Without pencil.]

Reduce to whole or mixed numbers:

1. $\frac{8}{2}$, $\frac{6}{3}$, $\frac{8}{4}$.
2. $\frac{7}{2}$, $\frac{9}{4}$, $\frac{11}{3}$.
3. $\frac{16}{4}$, $\frac{17}{3}$, $\frac{36}{12}$.
4. $\frac{40}{8}$, $\frac{21}{4}$, $\frac{13}{3}$.
5. $\frac{10}{4}$, $\frac{17}{2}$, $\frac{27}{4}$.
6. $\frac{55}{11}$, $\frac{48}{7}$, $\frac{64}{8}$.
7. $\frac{12}{9}$, $\frac{16}{5}$, $\frac{24}{8}$.
8. $\frac{40}{5}$, $\frac{33}{4}$, $\frac{10}{3}$.
9. $\frac{17}{3}$, $\frac{30}{8}$, $\frac{38}{6}$.
10. $\frac{14}{4}$, $\frac{21}{6}$, $\frac{60}{12}$.
11. $\frac{72}{9}$, $\frac{84}{9}$, $\frac{45}{5}$.
12. $\frac{35}{9}$, $\frac{32}{8}$, $\frac{76}{8}$.

27. Reduction of Mixed Numbers

[Without pencil.]

How many quarters of a yard are there in $2\frac{3}{4}$ yards?

In 1 yard there are $\frac{4}{4}$. In $2\frac{3}{4}$ (2 and $\frac{3}{4}$) yards there are $2 \times \frac{4}{4} + \frac{3}{4}$. $2 \times \frac{4}{4} = \frac{8}{4}$. $\frac{8}{4} + \frac{3}{4} = \frac{11}{4}$. $2\frac{3}{4}$ yd. = $\frac{11}{4}$ yd.

1. How many eighths of an inch are there in $1\frac{1}{8}$ inches? Explain.
2. How many half hours are there in $3\frac{1}{2}$ hours? Explain.

3. How many thirds of an apple in $4\frac{2}{3}$ apples? Explain.

It will be noticed that the answer for each of the last four problems could have been found by multiplying the integer by the denominator of the fraction, adding the numerator to their product, and placing the result over the denominator.

To reduce a mixed number to an improper fraction, multiply the integer by the denominator of the fraction, add the numerator to the product, and place the result over the denominator.

Reduce to improper fractions:

4. $1\frac{1}{2}$, $1\frac{1}{3}$, $2\frac{1}{2}$.
5. $3\frac{1}{5}$, $2\frac{1}{3}$, $4\frac{1}{4}$.
6. $1\frac{4}{7}$, $3\frac{2}{4}$, $2\frac{2}{5}$.
7. $4\frac{5}{8}$, $3\frac{5}{6}$, $6\frac{3}{7}$.
8. $9\frac{1}{3}$, $11\frac{1}{7}$, $8\frac{1}{6}$.
9. $4\frac{2}{3}$, $5\frac{3}{8}$, $9\frac{3}{8}$.
10. $10\frac{1}{2}$, $14\frac{1}{3}$, $8\frac{7}{8}$.
11. $2\frac{1}{12}$, $11\frac{3}{8}$, $12\frac{1}{4}$.
*12. $15\frac{3}{8}$, $40\frac{1}{3}$, $25\frac{3}{4}$.

28. Review [1]

[Without pencil.]

1. Classify each of the following as a proper fraction, as an improper fraction, or as a mixed number:

$\frac{3}{4}$, $\frac{4}{3}$, $\frac{5}{5}$, $2\frac{1}{3}$, $25\frac{1}{4}$, $\frac{8}{3}$, $\frac{13}{12}$, $\frac{5}{16}$, $14\frac{3}{4}$, $\frac{7}{3}$.

Reduce to lowest terms:

2. $\frac{3}{6}$, $\frac{4}{6}$, $\frac{9}{12}$.
3. $\frac{5}{15}$, $\frac{7}{35}$, $\frac{18}{20}$.
4. $\frac{4}{8}$, $\frac{10}{24}$, $\frac{12}{18}$.
5. $\frac{14}{21}$, $\frac{11}{44}$, $\frac{12}{18}$.
6. $\frac{37}{80}$, $\frac{32}{48}$, $\frac{12}{24}$.
*7. $\frac{150}{120}$, $\frac{168}{200}$, $\frac{15}{60}$.

Reduce to whole or mixed numbers:

8. $\frac{18}{2}$, $\frac{21}{4}$, $\frac{15}{3}$.
9. $\frac{11}{3}$, $\frac{38}{8}$, $\frac{45}{9}$.
10. $\frac{24}{7}$, $\frac{10}{8}$, $\frac{35}{5}$.
11. $\frac{63}{7}$, $\frac{81}{4}$, $\frac{50}{2}$.
12. $\frac{24}{3}$, $\frac{29}{7}$, $\frac{40}{4}$.
*13. $\frac{116}{6}$, $\frac{452}{4}$, $\frac{875}{7}$.

Reduce to improper fractions:

14. $3\frac{1}{4}$, $2\frac{1}{7}$, $1\frac{1}{8}$.
15. $5\frac{3}{8}$, $4\frac{3}{4}$, $3\frac{5}{6}$.
16. $2\frac{1}{2}$, $6\frac{3}{8}$, $11\frac{1}{2}$.
17. $9\frac{3}{8}$, $7\frac{5}{8}$, $5\frac{3}{6}$.
18. $6\frac{3}{8}$, $8\frac{1}{4}$, $3\frac{1}{6}$.
*19. $12\frac{3}{8}$, $14\frac{1}{6}$, $16\frac{3}{8}$.

[1] In this work it will be found helpful to give daily practice, using fraction cards covering all the forms of reduction. See footnote, page 41.

29. Progress Score

Try within a limit of 15 minutes to make a score of 100 points in this exercise, counting for each correct answer the score given in parenthesis below the letter of the problem.

[Copy problems only when necessary.]

I. Add:

A. [illegible]	B. $24.[illegible]	C. [illegible]	D. [illegible]
(4) 24[illegible]	(5) 36.82	(3)	(3)
675	9.76		
809	38.24	E. [illegible]	F. [illegible]
678	16.[illegible]	(4)	(5)

II. Subtract:

G. [illegible]	H. $14.00	I. [illegible]	J. [illegible]
(3) 2189	(4) 2.24	(4)	(5)

III. Multiply:

K. 9607	L. 1427	M. $4.25
(4) 8	(6) 49	(7) 307

IV. Divide:

N.	O.	P.
(7) 9[illegible]	(10) [illegible] $204.[illegible]	(11) 573[illegible]

V. Reduce:

Q. To lowest terms: [illegible]
(5)

R. To whole or mixed numbers: [illegible]
(3)

S. To improper fractions: [illegible]
(5)

[illegible]

CHAPTER III. OUTDOOR SPORTS

30. Athletic Records

[Without pencil.]

1. Every year, mile records are taken of the time required by men and boys in running, walking, rowing, swimming, and skating. In which kind of race do you think a mile has been covered in the least time?

2. Read the following records in order of the time taken, putting the sport first in which a mile has been covered in the least time:

ONE MILE RECORDS

Running	4 min.	15 sec.
Running (Relay with 5 men)	3 "	17 "
Walking	6 "	30 "
Swimming	23 "	17 "
Rowing	6 "	5 "
Skating	2 "	36 "

3. In a boys' swimming contest, the winner swam fifty yards in 30 seconds. What part of a minute did he take?

4. In a boys' half-mile relay race (4 boys), a record of 1 minute 45 seconds has been made. Express the record in minutes.

5. Express in minutes the first record in running given on page 47; also, the record in walking.

6. What part of a foot is 6 in.? 3 in.? 9 in.?

7. Express in feet a record of 4 ft. 6 in. for a running high jump. Of 16 ft. 9 in. for a running broad jump.

31. Addition of Like Fractions

I

John is training for a rowing contest. Every morning he rows $\frac{3}{8}$ of a mile across a lake and then takes a course $\frac{7}{8}$ of a mile long that brings him back to his starting point. What is the distance covered in his morning row?

$\frac{3}{8}$ mi. + $\frac{7}{8}$ mi. = ?

$\frac{3}{8} + \frac{7}{8} = \frac{10}{8}$. $\frac{10}{8} = 1\frac{2}{8}$, or $1\frac{1}{4}$.

The distance covered is $1\frac{1}{4}$ miles.

Notice that the denominators in the two fractions $\frac{3}{8}$ and $\frac{7}{8}$ are the same. The fractions are, therefore, called **like fractions.** Fractions that have different denominators are called **unlike fractions.**

$\frac{5}{16}$, $\frac{3}{16}$, $\frac{11}{16}$, are like fractions. $\frac{1}{4}$, $\frac{1}{8}$, and $\frac{1}{2}$ are unlike fractions.

To add like fractions add the numerators, place the result over the denominator, and reduce if necessary.

[Without pencil.]

1. What is the sum of $\frac{5}{16}$ and $\frac{3}{16}$? Of $\frac{5}{7}$ and $\frac{6}{7}$? Of $\frac{8}{11}$ and $\frac{5}{11}$?

2. To reach the football grounds belonging to his school, Frank must ride $\frac{3}{4}$ of a mile on a trolley car and then walk $\frac{3}{4}$ of a mile. How far must he travel?

3. The sails of a boat are to be mended. One sail requires $\frac{7}{8}$ of a yard of canvas; the other sail, $\frac{5}{8}$ of a yard. How many yards are needed for the two sails?

Complete:

4. $\frac{1}{3} + \frac{2}{3} = ?$
5. $\frac{3}{8} + \frac{4}{8} = ?$
6. $\frac{5}{12} + \frac{7}{12} = ?$
7. $\frac{7}{8} + \frac{7}{8} = ?$
8. $\frac{7}{10} + \frac{8}{10} = ?$
9. $\frac{5}{7} + \frac{4}{7} = ?$
10. $\frac{3}{4} + \frac{3}{4} + \frac{1}{4} = ?$
11. $\frac{5}{8} + \frac{5}{8} + \frac{5}{8} = ?$
12. $\frac{11}{16} + \frac{7}{16} + \frac{5}{16} + \frac{3}{16} = ?$

II

Two knapsacks are to be made. One requires $1\frac{3}{4}$ yards of cloth; the other, $2\frac{3}{4}$ yards. How many yards are required for the two?

$1\frac{3}{4}$ yd. + $2\frac{3}{4}$ yd. = ?

$1\frac{3}{4}$	The sum of the fractions equals $\frac{3}{4} + \frac{3}{4}$, or $\frac{6}{4}$. $\frac{6}{4} = 1\frac{1}{2}$.
$2\frac{3}{4}$	The sum of the integers equals $2 + 1$, or 3.
$\frac{6}{4} = 1\frac{1}{2}$	The sum of the integers and fractions equals $3 + 1\frac{1}{2}$, or $4\frac{1}{2}$.
$3 + 1\frac{1}{2} = 4\frac{1}{2}$	The amount of cloth required is $4\frac{1}{2}$ yards.

[Use pencil only when needed.]

1. Give directions for adding mixed numbers that contain like fractions.

2. What is the sum of $4\frac{3}{8}$ and $8\frac{3}{8}$? Of $6\frac{6}{7}$ and $8\frac{1}{7}$? Of $14\frac{7}{8}$ and $8\frac{1}{8}$?

3. In buying camp supplies, Henry buys $2\frac{1}{2}$ lb. of coffee, $4\frac{1}{2}$ lb. of butter, and $8\frac{1}{2}$ lb. of sugar. What is the weight of the supplies?

4. Going to camp, Tom had to carry one package weighing $14\frac{3}{4}$ pounds, and one weighing $4\frac{3}{4}$ pounds. How much did both weigh?

5. Fred and his brother rowed a boat down a river. The first hour they rowed $6\frac{7}{8}$ miles; the second hour, $5\frac{3}{8}$ miles; and the third hour, $5\frac{7}{8}$ miles. What was the distance covered?

Find the value of:

6. $12\frac{3}{4} + \frac{1}{4}$.
7. $4\frac{3}{8} + \frac{3}{8}$.
8. $7\frac{1}{8} + \frac{3}{8}$.
9. $5\frac{1}{16} + \frac{3}{16}$.
10. $2\frac{5}{12} + 3\frac{1}{12}$.
11. $8\frac{3}{7} + 4\frac{2}{7}$.
12. $9\frac{3}{4} + 8\frac{3}{4}$.
13. $6\frac{7}{8} + 3\frac{7}{8}$.
14. $2\frac{1}{7} + 4\frac{3}{7} + 3\frac{3}{7}$.
15. $9\frac{1}{8} + 3\frac{3}{8} + 4\frac{3}{8}$.
16. $24\frac{5}{12} + 12\frac{7}{12} + 32\frac{5}{12}$.
17. $40\frac{11}{16} + 25\frac{3}{16} + 8\frac{7}{16}$.

32. Subtraction of Like Fractions

I

How much wider is a lake that is $\frac{7}{8}$ of a mile in width than one that is $\frac{3}{8}$ of a mile in width?

$\frac{7}{8}$ mi. − $\frac{3}{8}$ mi. = ?

$\frac{7}{8} - \frac{3}{8} = \frac{4}{8}$ or $\frac{1}{2}$.

The difference in the width of the lakes is $\frac{1}{2}$ mile.

To subtract like fractions, subtract the numerators, place the result over the denominator, and reduce if necessary.

[Without pencil.]

1. Find the difference between $\frac{3}{5}$ and $\frac{5}{5}$. Between $\frac{11}{12}$ and $\frac{7}{12}$. Between $\frac{11}{13}$ and $\frac{8}{13}$.

2. $\frac{3}{5} - \frac{5}{5} = ?$	5. $\frac{8}{13} - \frac{8}{13} = ?$	8. $\frac{7}{8} - \frac{1}{8} = ?$	11. $\frac{11}{12} - \frac{8}{12} = ?$
3. $\frac{7}{8} - \frac{3}{8} = ?$	6. $\frac{11}{12} - \frac{7}{12} = ?$	9. $\frac{7}{13} - \frac{8}{13} = ?$	12. $\frac{11}{13} - \frac{4}{13} = ?$
4. $\frac{11}{13} - \frac{8}{13} = ?$	7. $\frac{7}{8} - \frac{3}{8} = ?$	10. $\frac{11}{13} - \frac{8}{13} = ?$	13. $\frac{7}{12} - \frac{1}{12} = ?$

II

How much is left from a coil of wire containing $60\frac{3}{8}$ yards after $24\frac{5}{8}$ yards have been used?

$60\frac{3}{8}$ yd. − $24\frac{5}{8}$ yd. = ?

$60\frac{3}{8}$ The difference between the fractions is $\frac{3}{8} - \frac{5}{8}$ or $\frac{1}{8}$.

$24\frac{5}{8}$ The difference between the integers is $60 - 24$ or 36.

$36\frac{1}{8}$ The total difference equals $36 + \frac{1}{8}$ or $36\frac{1}{8}$.

The number of yards left in the coil of wire is $36\frac{1}{8}$ yards.

[Use pencil only when needed.]

1. Give directions for subtracting mixed numbers that contain like fractions.

2. Subtract: $4\frac{1}{8}$ from $8\frac{1}{8}$; $5\frac{1}{12}$ from $9\frac{1}{12}$; $12\frac{1}{8}$ from $18\frac{7}{8}$.

3. In making a bow for arrows, Tom cut a piece of wood $4\frac{1}{2}$ inches long from a strip $40\frac{1}{2}$ inches long, and used the piece left for the bow. How long did he make his bow?

4. Tom made one arrow $24\frac{3}{4}$ inches long, and another $21\frac{1}{4}$ inches long. What was the difference in their lengths?

5. Fred bought $1\frac{7}{8}$ yards of muslin for the sails of a toy airship and used $1\frac{5}{8}$ yards. What was the length of the piece left?

6. $5\frac{5}{7} - \frac{3}{7} = ?$

7. $2\frac{5}{6} - \frac{1}{6} = ?$

8. $18\frac{11}{12} - \frac{5}{12} = ?$

9. $8\frac{4}{5} - 3\frac{3}{5} = ?$

10. $14\frac{8}{11} - 5\frac{3}{11} = ?$

11. $2\frac{7}{8} - 1\frac{3}{8} = ?$

12. $8\frac{5}{6} - 3\frac{1}{6} = ?$

13. $12\frac{7}{16} - 5\frac{3}{16} = ?$

14. $8\frac{7}{12} - 3\frac{1}{12} = ?$

15. $40\frac{11}{15} - 32\frac{8}{15} = ?$

16. $72\frac{11}{24} - 50\frac{5}{24} = ?$

17. $86\frac{5}{8} - 38\frac{7}{16} = ?$

*18. From the sum of $114\frac{3}{8}$ and $42\frac{7}{8}$, subtract $75\frac{1}{8}$.

*19. To the difference between $24\frac{7}{16}$ and $18\frac{1}{16}$, add $36\frac{5}{16}$.

33. Finding a Common Denominator

I

[Without pencil.]

In order to add $\frac{1}{2}$ and $\frac{1}{4}$, one half, as you learned on page 36, is changed to fourths. $\frac{1}{2} = \frac{2}{4}$. The sum of the fractions is, therefore, the sum of $\frac{2}{4}$ and $\frac{1}{4}$, or $\frac{3}{4}$.

When the same denominator is given to two or more fractions, they are said to have a **common denominator.**

4 is a common denominator for fourths and halves.

1. What number can be used as a common denominator for $\frac{1}{4}$ and $\frac{1}{8}$? For $\frac{1}{6}$ and $\frac{1}{3}$? For $\frac{1}{12}$ and $\frac{1}{3}$?

2. What is the smallest number that can be divided by both 4 and 5 without a remainder? What is the smallest number that can be used as a common denominator for $\frac{1}{4}$ and $\frac{1}{5}$?

The smallest number that can be used as a common denominator of two or more fractions is called their **least common denominator.**

The least common denominator of $\frac{1}{2}$ and $\frac{1}{3}$ is 6; of $\frac{1}{6}$ and $\frac{1}{3}$ is 9; of $\frac{1}{4}$ and $\frac{1}{3}$ is 12; of $\frac{1}{4}$ and $\frac{1}{5}$ is 20.

To find the least common denominator of two or more fractions, find the smallest number that is exactly divisible by their denominators.

Find the least common denominator of:[1]

3. $\frac{1}{2}$ and $\frac{3}{8}$.	7. $\frac{1}{3}$ and $\frac{3}{7}$.	11. $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$.
4. $\frac{4}{5}$ and $\frac{5}{6}$.	8. $\frac{1}{12}$ and $\frac{3}{8}$.	12. $\frac{1}{2}$, $\frac{1}{5}$, and $\frac{1}{10}$.
5. $\frac{1}{2}$ and $\frac{2}{7}$.	9. $\frac{2}{3}$ and $\frac{1}{5}$.	*13. $\frac{1}{10}$, $\frac{1}{4}$, and $\frac{1}{15}$.
6. $\frac{1}{2}$ and $\frac{2}{5}$.	10. $\frac{2}{3}$ and $\frac{1}{4}$.	*14. $\frac{1}{12}$, $\frac{1}{16}$, and $\frac{3}{4}$.

II

Change $\frac{3}{8}$ and $\frac{5}{6}$ to the least common denominator.

Since 24 is the smallest number that can be divided by both 8 and 6 without a remainder, 24 is used as the least common denominator.

By what number is it necessary to multiply both terms to change $\frac{3}{8}$ to twenty-fourths? To change $\frac{5}{6}$ to twenty-fourths? How is each number found?

$\frac{3}{8} = \frac{9}{24}$	$\frac{5}{6} = \frac{9}{24}$
Think: $\frac{3}{8} = \frac{3 \times 3}{8 \times 3} = \frac{9}{24}$	Think: $\frac{5}{6} = \frac{5 \times 4}{6 \times 4} = \frac{20}{24}$
Write: $\frac{3}{8} = \frac{9}{24}$	Write: $\frac{5}{6} = \frac{20}{24}$

[Use pencil only when needed.]

1. In changing $\frac{3}{4}$ to twelfths, by what number is it necessary to multiply both terms?

2. Explain how to change $\frac{3}{4}$ and $\frac{4}{5}$ to fifteenths, $\frac{3}{4}$ and $\frac{3}{5}$ to twentieths, $\frac{4}{5}$, $\frac{1}{3}$, and $\frac{1}{3}$ to thirtieths.

3. Change to a common denominator the fractions in each problem in the exercise at the top of this page.

When you have difficulty in finding the least common denominator of a group of fractions, count by the largest number used as a denominator until you find a number that is divisible by the other denominators. In finding the least common denominator of $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$, think 8, 16, 24. Since neither 8 nor 16 is divisible by 3 and 4, but 24 is, we know that 24 is the least common denominator of $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$.

34. Addition and Subtraction of Unlike Fractions

(1) What is a boy's swimming record for a day, if he swims $\frac{3}{4}$ of a mile in the morning and $\frac{5}{8}$ of a mile in the afternoon?

(2) What is the difference between the record made in the morning and the one made in the afternoon?

(1)

$\frac{3}{4}$ mi. + $\frac{5}{8}$ mi. = ?

$$\begin{array}{r|r} \frac{3}{4} & \frac{6}{8} \\ \frac{5}{8} & \frac{5}{8} \\ \hline & \frac{11}{8} = 1\frac{3}{8} \end{array}$$

Total distance = $1\frac{3}{8}$ miles.

(2)

$\frac{3}{4}$ mi. − $\frac{5}{8}$ mi. = ?

$$\begin{array}{r|r} \frac{3}{4} & \frac{6}{8} \\ \frac{5}{8} & \frac{5}{8} \\ \hline & \frac{1}{8} \end{array}$$

The difference = $\frac{1}{8}$ of a mile.

To add or subtract unlike fractions, first change them to a common denominator.

[Use pencil only when needed.]

1. Find the sum of $\frac{3}{5}$ and $\frac{8}{10}$. Of $\frac{3}{4}$ and $\frac{1}{3}$. Of $\frac{3}{8}$ and $\frac{1}{4}$.

2. Find the difference between $\frac{7}{8}$ and $\frac{1}{4}$. Between $\frac{8}{10}$ and $\frac{1}{2}$. Between $\frac{5}{8}$ and $\frac{1}{4}$.

3. In going to his favorite fishing pool, Tom traveled in his canoe $\frac{2}{3}$ of a mile on a lake and $\frac{3}{4}$ of a mile up a stream. How far did he travel?

4. Tom caught three trout. The first weighed $\frac{7}{8}$ of a pound; the second, $\frac{5}{6}$ of a pound; and the third, $\frac{3}{4}$ of a pound. How much did they weigh together?

5. Which trout weighed the most? How much more did it weigh than the smallest trout?

6. What is the difference in the weight of two fish when one weighs $\frac{7}{8}$ of a pound and the other $\frac{1}{2}$ pound.

Add:

[illegible]

Subtract:

[illegible]

[illegible]. From [illegible] subtract [illegible].

[illegible]. Find the difference between [illegible] and [illegible], and [illegible].

[illegible]. Addition of Mixed Numbers

An automobile traveled [illegible] miles the first day, [illegible] miles the second day, and [illegible] miles the third day. What is the distance traveled in the three days?

[illegible] mi. + [illegible] mi. + [illegible] mi. = ?

[illegible]

In adding the fractions, the fractions are changed to a common denominator and then added. The least common denominator is [illegible] ... [illegible]

The sum of the fractions is then added to the sum of the integers. [illegible]

The distance traveled is [illegible] miles.

Written work.

[illegible]. What is the sum of [illegible], [illegible], [illegible], and [illegible]?

[illegible]. [illegible] walked [illegible] miles in the morning and [illegible] miles in the afternoon. How far did he walk that day?

[illegible]. [illegible] is training for a walking contest. His record for three days was as follows: the first day, [illegible] miles; the second day, [illegible] miles; the third day, [illegible] miles. Find the total distance covered.

Find the sums:

4. $12\frac{1}{3}$	5. $20\frac{2}{3}$	6. $3\frac{1}{5}$	7. $4\frac{1}{4}$	8. $48\frac{1}{4}$	9. $18\frac{2}{3}$
$8\frac{1}{2}$	$4\frac{1}{4}$	$7\frac{1}{2}$	$1\frac{2}{5}$	$32\frac{5}{16}$	$12\frac{4}{9}$
10. $20\frac{2}{3}$	11. $4\frac{1}{3}$	12. $2\frac{1}{5}$	13. $8\frac{1}{2}$	14. $5\frac{1}{2}$	15. $6\frac{1}{3}$
$6\frac{1}{2}$	$6\frac{2}{3}$	$3\frac{3}{4}$	$6\frac{1}{3}$	$7\frac{3}{4}$	$17\frac{1}{4}$
$3\frac{3}{4}$	$8\frac{1}{5}$	$1\frac{1}{2}$	$4\frac{5}{6}$	$2\frac{5}{8}$	$24\frac{1}{6}$

*16. Find the sum of $\frac{8}{10}$, $\frac{3}{5}$, and $\frac{3}{8}$. Of $114\frac{1}{2}$, $72\frac{5}{16}$, $14\frac{1}{32}$.

36. Subtraction of Mixed Numbers

What is the difference in the rate of travel of an airship going at the rate of $62\frac{3}{4}$ miles an hour, and that of a fast express train beneath it going at the rate of $55\frac{1}{5}$ miles an hour?

$62\frac{3}{4}$ mi. $- 55\frac{1}{5}$ mi. $= ?$

The least common denominator of $\frac{3}{4}$ and $\frac{1}{5}$ is 20.

$$\begin{array}{r|l} 62\frac{3}{4} & \frac{15}{20} \\ 55\frac{1}{5} & \frac{4}{20} \\ \hline 7\frac{11}{20} & \end{array}$$

$\frac{3}{4} = \frac{15}{20}$. $\quad \frac{15}{20} - \frac{4}{20} = \frac{11}{20}$

$\frac{1}{5} = \frac{4}{20}$. $\quad 62 - 55 = 7$

$7 + \frac{11}{20} = 7\frac{11}{20}$

The difference in the rate of travel $= 7\frac{11}{20}$ miles.

[With pencil.]

1. $18\frac{2}{3} - 5\frac{1}{4} = ?$ $\quad 12\frac{3}{5} - 2\frac{1}{2} = ?$ $\quad 14\frac{3}{4} - 8\frac{1}{5} = ?$ $\quad 10\frac{5}{6} - 4\frac{1}{4} = ?$

2. Henry's record in making a running broad jump was $12\frac{1}{2}$ feet. Tom's record was $14\frac{3}{4}$ feet. How much farther did Tom jump?

3. The longest distance Fred has walked at one time is $15\frac{3}{4}$ miles. The longest distance his younger brother has walked is $8\frac{1}{3}$ miles. What is the difference in their records?

4. The heaviest weight that Charles can lift is $75\frac{3}{4}$ pounds. The heaviest weight that Frank can lift is $68\frac{3}{8}$ pounds. Find the difference in the weights.

Find the differences:

5. $24\frac{5}{8}$	6. $32\frac{5}{6}$	7. $142\frac{2}{3}$	8. $88\frac{1}{2}$	9. $95\frac{1}{2}$	10. $120\frac{3}{4}$
$13\frac{1}{2}$	$16\frac{2}{3}$	$40\frac{1}{4}$	$12\frac{1}{3}$	$35\frac{3}{8}$	$20\frac{1}{3}$
11. $72\frac{5}{6}$	12. $142\frac{2}{3}$	13. $148\frac{5}{12}$	14. $280\frac{4}{9}$	15. $96\frac{2}{3}$	16. $524\frac{7}{8}$
$48\frac{1}{4}$	$28\frac{1}{2}$	$124\frac{1}{6}$	$130\frac{1}{8}$	$24\frac{1}{3}$	$320\frac{1}{8}$

*17. Subtract from $84\frac{2}{3}$ the sum of $24\frac{1}{4}$ and $18\frac{1}{3}$.

*18. From $14\frac{2}{3} + 12\frac{1}{8}$, subtract $8\frac{1}{2} + 4\frac{1}{6}$.

37. Changing the Minuend in Subtraction

I

In order to pay a half-dollar or a quarter out of a two-dollar bill, it is necessary to change the bill. In like manner, when a fractional part is to be taken from a whole number, the form of the whole number must be changed.

What number is left when the fraction $\frac{1}{4}$ is taken from 8?

$8 - \frac{1}{4} = ?$

$8 = 7\frac{4}{4}$. $7\frac{4}{4} - \frac{1}{4} = 7\frac{3}{4}$.

The number left is $7\frac{3}{4}$.

[Without pencil.]

Complete:

1. $4 - \frac{2}{3} = ?$	4. $5 - 2\frac{1}{2} = ?$	7. $12 - 5\frac{3}{4} = ?$	10. $14 - 6\frac{5}{12} = ?$
2. $8 - \frac{3}{4} = ?$	5. $8 - 3\frac{1}{4} = ?$	8. $9 - 3\frac{2}{3} = ?$	11. $11 - 7\frac{5}{6} = ?$
3. $10 - \frac{2}{5} = ?$	6. $12 - 6\frac{1}{3} = ?$	9. $15 - 5\frac{1}{8} = ?$	12. $20 - 8\frac{3}{16} = ?$

13. How many yards are left when $\frac{1}{8}$ of a yard is taken from 2 yards?

14. From a line 12 inches long, $8\frac{3}{4}$ inches are erased. How many inches are there in the line that is left?

15. From a box containing 5 pounds of candy, $2\frac{1}{4}$ pounds are taken. How many pounds are left in the box?

II

How much longer is a line $14\frac{2}{3}$ yards long than one $9\frac{3}{4}$ yards long?

$14\frac{2}{3}$ yd. $- 9\frac{3}{4}$ yd. = ?

Think:

$$\begin{array}{r|l} 13\frac{12}{12} & \\ 14\frac{2}{3} & \frac{8}{12} + \frac{12}{12} = \frac{20}{12} \\ 9\frac{3}{4} & \frac{9}{12} \\ \hline 4\frac{11}{12} & \end{array}$$

Write:

$$\begin{array}{r|l} 14\frac{2}{3} & \frac{8}{12} \\ 9\frac{3}{4} & \frac{9}{12} \\ \hline 4\frac{11}{12} & \end{array}$$

In solving this problem, the fractions are first changed to a common denominator: $\frac{2}{3} = \frac{8}{12}$; $\frac{3}{4} = \frac{9}{12}$. Then, since $\frac{9}{12}$ cannot be subtracted from $\frac{8}{12}$, 1 is taken from the integer in the minuend and added to the fraction in the minuend. The 14 is changed to $13\frac{12}{12}$. The 1, or $\frac{12}{12}$, added to the $\frac{8}{12}$ makes $\frac{20}{12}$. The problem then stands: $13\frac{20}{12} - 9\frac{9}{12}$ = ?

Notice that when fractions have unlike denominators, as in the problem above, they are reduced to a common denominator before the change is made in the integer.

[With pencil.]

Find answers:

1. $12\frac{1}{4} - 3\frac{1}{2}$ = ?
2. $6\frac{1}{2} - 2\frac{3}{4}$ = ?
3. $5\frac{1}{3} - 2\frac{5}{6}$ = ?
4. $18\frac{1}{8} - 3\frac{5}{16}$ = ?
5. $24\frac{1}{2} - 9\frac{11}{12}$ = ?
6. $5\frac{1}{8} - 2\frac{5}{8}$ = ?
7. $7\frac{1}{4} - 3\frac{3}{4}$ = ?
8. $10\frac{1}{6} - 4\frac{5}{6}$ = ?
9. $44\frac{1}{8} - 20\frac{1}{2}$ = ?
10. $50\frac{1}{3} - 22\frac{3}{4}$ = ?
11. $40 - 17\frac{3}{4}$ = ?
12. $75 - 24\frac{1}{2}$ = ?
13. $72 - 36\frac{3}{8}$ = ?
14. $48\frac{1}{16} - 23\frac{9}{16}$ = ?
15. $80\frac{1}{12} - 40\frac{5}{12}$ = ?
16. $9\frac{2}{3} - 4\frac{3}{4}$ = ?
17. $14\frac{1}{8} - 3\frac{1}{2}$ = ?
18. $22\frac{1}{8} - 3\frac{2}{3}$ = ?

*19. $60\frac{1}{12} - 20\frac{5}{16}$ = ?

*20. $72\frac{1}{80} - 36\frac{7}{20}$ = ?

21. From a fish line 40 yards long, a piece $18\frac{3}{4}$ yards long is cut. How many yards are left?

22. In one part of its course a stream is $4\frac{1}{4}$ rods in width; in another part, $2\frac{1}{2}$ rods. What is the difference in the width of the stream at the two points named?

23. How much deeper is a swimming pool that is $8\frac{1}{3}$ feet deep than one that is $5\frac{1}{2}$ feet deep?

38. Test and Graded Practice

This test is to help you find out and overcome your difficulties in the addition and subtraction of fractions. If you fail to get the right answer to a problem in the test, practice solving the problems in the set below having the same letter. If you have no trouble with the test, improve your work by solving the starred problems in exercise H.

Test No. 12.

A. $12\frac{3}{8} + 4\frac{7}{8} = ?$

B. $3\frac{5}{12} + 2\frac{5}{6} = ?$

C. $8\frac{5}{6} + 4\frac{3}{8} = ?$

D. $7\frac{11}{16} - 2\frac{5}{16} = ?$

E. $11\frac{7}{9} - 2\frac{1}{3} = ?$

F. $9\frac{5}{8} - 2\frac{1}{12} = ?$

G. $12\frac{1}{4} - 7\frac{2}{3} = ?$

PRACTICE

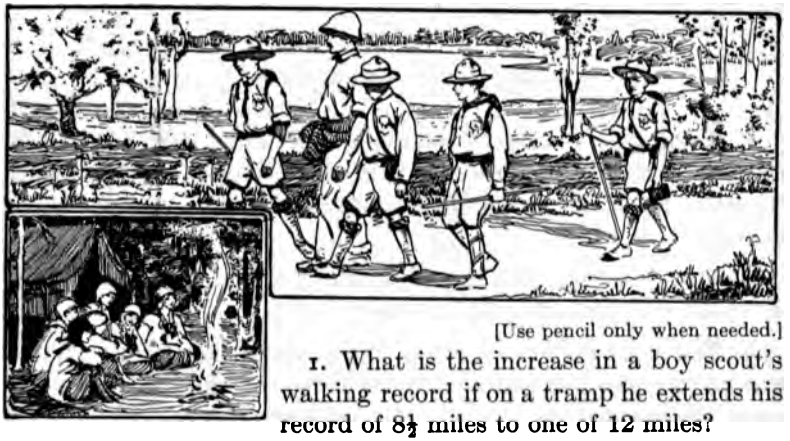
Do work indicated:[1] [Copy problems only when necessary.]

A.	B.	C.	D.
1. $\frac{2}{5} + \frac{1}{5}$.	7. $\frac{3}{8} + \frac{1}{4}$.	13. $\frac{1}{6} + \frac{3}{8}$.	19. $\frac{7}{9} - \frac{5}{9}$.
2. $\frac{5}{7} + \frac{2}{7}$.	8. $\frac{1}{2} + \frac{1}{6}$.	14. $\frac{1}{2} + \frac{4}{5}$.	20. $\frac{5}{16} - \frac{1}{16}$.
3. $\frac{7}{8} + \frac{5}{8}$.	9. $\frac{8}{9} + \frac{1}{3}$.	15. $\frac{5}{6} + \frac{7}{8}$.	21. $8\frac{2}{3} - 5$.
4. $3\frac{2}{9} + 4\frac{5}{9}$.	10. $2\frac{1}{2} + 3\frac{1}{4}$.	16. $2\frac{1}{4} + 1\frac{1}{6}$.	22. $7\frac{4}{5} - 1\frac{1}{5}$.
5. $8\frac{4}{5} + 5\frac{3}{5}$.	11. $4\frac{1}{6} + 2\frac{1}{3}$.	17. $5\frac{1}{2} + 2\frac{2}{3}$.	23. $5\frac{3}{4} - 2\frac{1}{4}$.
6. $6\frac{7}{16} + 4\frac{11}{16}$.	12. $7\frac{1}{2} + 2\frac{5}{8}$.	18. $7\frac{5}{6} + 4\frac{4}{9}$.	24. $12\frac{11}{12} - 8\frac{1}{12}$.

E.	F.	G.	H.
25. $\frac{7}{8} - \frac{1}{4}$.	31. $\frac{1}{4} - \frac{1}{6}$.	37. $7 - 3\frac{1}{4}$.	*43. $14\frac{11}{16} + 8\frac{9}{16}$.
26. $\frac{5}{6} - \frac{1}{3}$.	32. $\frac{4}{5} - \frac{1}{2}$.	38. $12\frac{1}{3} - \frac{2}{3}$.	*44. $9\frac{11}{12} + 7\frac{5}{6}$.
27. $\frac{3}{4} - \frac{7}{12}$.	33. $\frac{5}{6} - \frac{3}{8}$.	39. $14\frac{2}{7} - 3\frac{5}{7}$.	*45. $15\frac{5}{12} + 8\frac{7}{8}$.
28. $8\frac{3}{4} - 2\frac{1}{2}$.	34. $7\frac{5}{6} - 2\frac{1}{4}$.	40. $6\frac{1}{2} - \frac{3}{4}$.	*46. $17\frac{5}{9} - 8\frac{2}{9}$.
29. $3\frac{5}{6} - 1\frac{1}{2}$.	35. $8\frac{2}{3} - 4\frac{1}{2}$.	41. $8\frac{1}{4} - 4\frac{2}{3}$.	*47. $14\frac{5}{12} - 5\frac{5}{6}$.
30. $9\frac{2}{3} - 5\frac{1}{6}$.	36. $7\frac{3}{4} - 4\frac{2}{3}$.	42. $7\frac{3}{8} - 2\frac{5}{6}$.	*48. $19\frac{5}{8} - 7\frac{11}{12}$.

[1] To play the game "Over-the-top" with any of these exercises, write the problems in the form of a ladder with the first problem at the bottom. Race with your classmates to get the right answers. The first one to do so goes over-the-top first.

39. In Camp



[Use pencil only when needed.]

1. What is the increase in a boy scout's walking record if on a tramp he extends his record of $8\frac{1}{2}$ miles to one of 12 miles?

2. What is the distance covered in a day by a group of camp-fire girls who walk $5\frac{3}{4}$ miles in the morning and $4\frac{1}{2}$ miles in the afternoon?

3. A mountain trail is $6\frac{1}{4}$ miles long. How far from the upper end of the trail are boys who have climbed $4\frac{3}{4}$ miles?

4. A lake is $2\frac{3}{4}$ miles across. How far from the farther shore is a canoe which has been paddled $1\frac{7}{8}$ miles across the lake?

5. John and his brothers row three miles. They cover the first mile in $12\frac{1}{2}$ minutes, the second mile in $14\frac{1}{4}$ minutes, and the third mile in $10\frac{3}{4}$ minutes. What is their record in minutes for the three miles?

6. How much greater is the distance covered by a boy who swims $\frac{1}{2}$ mile at a stretch than that covered by a boy who swims 220 yards ($\frac{1}{8}$ of a mile)?

7. What is the difference in time made in a hundred-yard swimming contest, between a record of $55\frac{2}{3}$ seconds and a record of 1 minute?

8. In a walking contest, the winner walked a mile in $8\frac{3}{4}$ minutes; the boy next in the contest took $10\frac{1}{4}$ minutes. What was the difference in the time?

40. On the Athletic Field

[Use pencil only when needed.]

1. A ball player takes $4\frac{3}{8}$ seconds to get to first base, $4\frac{1}{8}$ seconds to get to second base, $4\frac{3}{8}$ seconds to get to third base, and $4\frac{1}{8}$ seconds to get to the home plate. How many seconds does it take him to make a home run?

2. The time taken for the home run (problem 1) is how many seconds over a quarter of a minute?

3. In a relay race, the first boy takes $5\frac{4}{8}$ seconds for his part of the course; the second boy, $5\frac{3}{8}$ seconds; the third boy, $4\frac{4}{8}$ seconds. How much less than a half-minute was needed for the race?

4. What is the difference in the length of a running track $\frac{8}{16}$ of a mile long, and one $\frac{1}{8}$ of a mile long?

5. Find the difference in time between a record of $4\frac{3}{4}$ minutes for a mile run and one of $5\frac{1}{4}$ minutes.

6. Fred can take a running jump over a pole $5\frac{1}{2}$ feet from the ground; his brother can jump over the pole at $4\frac{1}{12}$ feet. What is the difference in the height of the jumps?

7. Albert can make a running broad jump of $12\frac{1}{2}$ feet; Charles's record is $14\frac{5}{12}$ feet. Find the difference.

*8. Use this table for making problems of your own. Solve your problems and then report your results to your classmates.

ATHLETIC RECORDS

	Grammar School	High School
Running high jump	$4\frac{1}{2}$ ft.	$5\frac{3}{4}$ ft.
Running broad jump	16 ft. $11\frac{1}{2}$ in.	21 ft. 2 in.
100 yard dash	11 sec.	$10\frac{3}{8}$ sec.
440 yard relay race	$55\frac{2}{8}$ sec.	$53\frac{3}{8}$ sec.

41. Review and Progress Score

I. Review

[Use pencil only when needed.]

1. Reduce to improper fractions: $5\frac{2}{3}$, $8\frac{1}{12}$, $10\frac{7}{8}$, $12\frac{5}{7}$, $9\frac{7}{8}$.
2. Reduce to mixed numbers: $\frac{14}{4}$, $\frac{22}{6}$, $\frac{36}{8}$, $\frac{66}{9}$, $\frac{100}{12}$.

Find answers:

3. $24\frac{5}{12} + 7\frac{1}{12} = ?$
4. $12\frac{3}{8} + 4\frac{7}{8} = ?$
5. $6\frac{3}{4} + 2\frac{1}{2} + 1\frac{1}{3} = ?$
6. $42\frac{7}{9} - 14\frac{5}{9} = ?$
7. $8\frac{5}{16} - 2\frac{1}{16} = ?$
8. $14\frac{3}{5} - 3\frac{1}{3} = ?$
9. $18 - 3\frac{5}{16} = ?$
10. $20\frac{1}{4} - 2\frac{5}{8} = ?$
11. $15\frac{2}{5} - 4\frac{7}{10} = ?$

II. Progress Score

Try to make a total record of 100 points on these exercises, counting for each correct answer the score given in parenthesis below the letter of the problem.

I. Add: [Copy problems only when necessary.]

A. (4)
427
356
840
279
546
328

B. (5)
$12.78
9.65
38.27
14.75
8.48
6.39

C. (5) $2\frac{1}{3}$
$4\frac{5}{8}$

D. (6) $6\frac{2}{3}$
$4\frac{2}{3}$

E. (6) $8\frac{5}{16}$
$3\frac{1}{4}$

F. (8) $16\frac{2}{3}$
$4\frac{3}{4}$

II. Subtract:

G. (2) 8234
1470

H. (3) $30.02
12.95

I. (7) $8\frac{2}{3}$
$3\frac{1}{4}$

J. (10) $16\frac{1}{6}$
$4\frac{5}{6}$

III. Multiply:

K. (4) 3498
7

L. (6) 624
38

M. (7) 567
504

N. (7) $12.24
213

IV. Divide:

O. (5) $9\overline{)51357}$

P. (5) $61\overline{)50264}$

Q. (10) $382\overline{)213920}$

CHAPTER IV. HOME INTERESTS

42. Household Supplies

[Without pencil.]

1. What fractional parts of a yard are commonly used in buying goods?

2. How many inches are there in $\frac{1}{2}$ yd.? In $\frac{1}{4}$ yd.? In $\frac{3}{4}$ of a yard? In $\frac{1}{3}$ of a yard? In $\frac{2}{3}$ of a yard?

3. What part of a yard is 12 inches? 9 inches? 27 inches? 18 inches? 24 inches?

4. A window curtain requires 3 yards 18 inches of muslin. How many yards are required?

5. Elizabeth finds that a table cover requires 2 yards 27 inches of goods. Express in yards the length required.

6. Express as yards: 1 yard 9 inches; 4 yards 27 inches, 3 yards 18 inches; 2 yards 12 inches; 1 yard 24 inches.

7. A floor requires 4 strips of matting of the same length. How can the number of yards required for the floor be found, if the length of each strip is known?

8. A piece of carpeting a given number of yards long is to be divided into 3 equal lengths. How can the length of each piece be found, if the length of the whole is known?

9. If the cost of a yard of cloth is known, how can the cost of $\frac{1}{3}$ of a yard be found? Of $\frac{2}{3}$ of a yard?

10. If the cost of $\frac{2}{3}$ of a yard is known, how can the cost of a yard be found?

11. A piece of toweling is to be cut into lengths $\frac{3}{4}$ of a yard long. How can the number of towels be found, if the entire length of the toweling is known?

43. The Fraction in Multiplication

I

[Use pencil for drawings only.]

1. In making cardboard boxes, Philip first cut a sheet of cardboard into halves, and then each half into four equal parts. Into how many equal parts did he cut the cardboard?

2. Philip used one of the pieces for each box. What part of the whole sheet did he use?

3. Elizabeth had half a yard of ribbon, which she divided into two equal parts. She used one of the equal parts for a needlebook. What part of a yard did she use?

4. What is $\frac{1}{4}$ of $\frac{1}{2}$? $\frac{1}{2}$ of $\frac{1}{2}$?

5. If a sheet of paper is folded into halves, and then each half is folded into thirds, how many parts does the sheet contain? The smallest part equals what part of the whole sheet?

6. What part of a sheet of paper is $\frac{1}{3}$ of $\frac{1}{2}$ a sheet?

7. How many parts does a sheet of paper contain when it is divided into thirds, and then each third is divided into fourths? What name is given to the smallest part?

8. What part of a sheet of paper is $\frac{1}{4}$ of $\frac{1}{3}$ of a sheet?

Show by a drawing what is meant by:

9. $\frac{1}{2}$ of $\frac{1}{2}$ of a circle.

10. $\frac{1}{4}$ of $\frac{1}{2}$ of a circle.

11. $\frac{1}{2}$ of $\frac{1}{3}$ of a square.

12. $\frac{1}{3}$ of $\frac{1}{3}$ of a square.

13. Answer, without drawing: $\frac{1}{2}$ of $\frac{1}{4}$ = ? $\frac{1}{2}$ of $\frac{1}{8}$ = ? $\frac{1}{3}$ of $\frac{1}{4}$ = ?

Problems such as $\frac{1}{2}$ of $\frac{1}{2}$ = ? may be expressed with the multiplication sign.

$\frac{1}{2}$ of $\frac{1}{2}$ = ? may be written $\frac{1}{2} \times \frac{1}{2}$ = ?
$\frac{1}{3}$ of $\frac{1}{2}$ = ? may be written $\frac{1}{3} \times \frac{1}{2}$ = ?

14. Find answers: $\frac{1}{4} \times \frac{1}{2}$ = ? $\frac{1}{3} \times \frac{1}{3}$ = ? $\frac{1}{4} \times \frac{1}{3}$ = ?

II

Henry had $\frac{3}{4}$ of a sheet of blotting paper. He used $\frac{3}{8}$ of it. What part of the whole sheet did he use?

$\frac{3}{8}$ of $\frac{3}{4}$ of a sheet of cardboard = ?

Think:
$\frac{3}{8}$ of $\frac{3}{4} = \frac{3}{8} \times \frac{3}{4}$. $\frac{3}{8} \times \frac{3}{4} = \frac{3 \times 3}{8 \times 4} = \frac{9}{32}$.
The part used was $\frac{9}{32}$ of the whole sheet.

Write:
$\frac{3}{8} \times \frac{3}{4} = \frac{9}{32}$.
$\frac{3}{8}$ of $\frac{3}{4}$ sheets = $\frac{9}{32}$ of a sheet.

To multiply one fraction by another, multiply the numerators together for a new numerator, and the denominators for a new denominator.

[Use pencil only when needed.]

1. Multiply: $\frac{2}{3}$ by $\frac{2}{5}$; $\frac{3}{7}$ by $\frac{3}{4}$; $\frac{3}{8}$ by $\frac{1}{2}$; $\frac{7}{8}$ by $\frac{1}{3}$; $\frac{2}{5}$ by $\frac{3}{4}$.

2. Robert made a reed basket for his mother's birthday present. He bought $\frac{1}{2}$ lb. of reed and used $\frac{3}{4}$ of it. What part of a pound did he use?

3. Helen made a silk workbag for Margaret. She had $\frac{7}{8}$ of a yard of silk and used $\frac{1}{2}$ of it. Find what part of a yard the workbag required.

4. What part of a yard is $\frac{2}{3}$ of $\frac{1}{2}$ yard? $\frac{2}{3}$ of $\frac{3}{4}$ of a yard?

5. $\frac{1}{4}$ of $\frac{1}{5}$ = ?
6. $\frac{3}{8}$ of $\frac{4}{5}$ = ?
7. $\frac{2}{3}$ of $\frac{1}{4}$ = ?
8. $\frac{1}{5}$ of $\frac{1}{2}$ = ?
9. $\frac{3}{7} \times \frac{2}{5}$ = ?
10. $\frac{4}{5} \times \frac{3}{11}$ = ?
11. $\frac{3}{4} \times \frac{1}{8}$ = ?
12. $\frac{1}{7} \times \frac{2}{3}$ = ?
13. $\frac{2}{5} \times \frac{1}{7}$ = ?
14. $\frac{2}{3} \times \frac{1}{5}$ = ?
15. $\frac{1}{4} \times \frac{3}{5}$ = ?
16. $\frac{3}{11} \times \frac{1}{4}$ = ?
17. $\frac{3}{7} \times \frac{4}{5}$ = ?
18. $\frac{1}{5} \times \frac{2}{5}$ = ?
19. $\frac{3}{4} \times \frac{3}{5}$ = ?
20. $\frac{3}{5} \times \frac{5}{7}$ = ?

III

(1) Allowing $\frac{3}{8}$ of a yard of ribbon for each badge, how many yards are required for 7 badges?

(2) At 25¢ a yard, what is the cost of the ribbon for each badge?

(1)	(2)
7 times $\frac{3}{8}$ of a yard = ?	$\frac{3}{8}$ of 25¢ = ?
$7 \times \frac{3}{8} = \frac{7 \times 3}{8} = \frac{21}{8}$, or $2\frac{5}{8}$.	$\frac{3}{8}$ of $25 = \frac{3 \times 25}{8} = \frac{75}{8}$, or $9\frac{3}{8}$.
Am't required = $2\frac{5}{8}$ yd.	Cost of each badge = $9\frac{3}{8}$¢.

In both problems above, one term is an integer, and the other a fraction. Each problem is solved by first multiplying the numbers above the line and placing the product above the denominator, and then reducing the answer.

[Use pencil only when needed.]

1. Multiply $\frac{3}{4}$ by 5; $\frac{7}{8}$ by 3; $\frac{2}{3}$ by 11; 9 by $\frac{1}{4}$; 8 by $\frac{3}{5}$.

2. Kitchen towels are to be made. Each requires $\frac{7}{8}$ of a yard of crash. How many yards must be bought for 9 towels?

3. How many yards of linen are required for 4 table napkins if each requires $\frac{3}{4}$ of a yard?

4. At 21¢ a pound, how much must be paid for $\frac{3}{4}$ of a pound of fruit?

5. At 45¢ a dozen, how much must be paid for $\frac{2}{3}$ of a dozen lemons?

Find answers:

6. $2 \times \frac{2}{5}$ = ?	12. $5 \times \frac{2}{11}$ = ?	18. $\frac{3}{4}$ of 9 = ?	24. $\frac{4}{5} \times 3$ = ?
7. $3 \times \frac{5}{8}$ = ?	13. $7 \times \frac{3}{4}$ = ?	19. $\frac{7}{8}$ of 5 = ?	25. $\frac{3}{4} \times 7$ = ?
8. $4 \times \frac{3}{7}$ = ?	14. $11 \times \frac{2}{3}$ = ?	20. $\frac{2}{5}$ of 7 = ?	26. $\frac{5}{6} \times 11$ = ?
9. $5 \times \frac{5}{6}$ = ?	15. $8 \times \frac{5}{7}$ = ?	21. $\frac{3}{7}$ of 8 = ?	27. $\frac{5}{7} \times 9$ = ?
10. $6 \times \frac{4}{5}$ = ?	16. $5 \times \frac{3}{8}$ = ?	22. $\frac{3}{8}$ of 9 = ?	28. $\frac{2}{3} \times 14$ = ?
11. $8 \times \frac{5}{9}$ = ?	17. $12 \times \frac{3}{5}$ = ?	23. $\frac{4}{5}$ of 12 = ?	29. $\frac{3}{5} \times 15$ = ?

30. Multiply the sum of $\frac{5}{16}$ and $\frac{1}{4}$ by $\frac{1}{2}$.

*31. From $\frac{3}{4}$ of 28, subtract $\frac{2}{3}$ of 16.

*32. To $\frac{4}{5} \times 18$, add $\frac{1}{6}$ of 25.

IV. Cancellation

Mary bought $\frac{3}{4}$ of a yard of silk and used $\frac{2}{3}$ of it. What part of a yard did she use?

$\frac{2}{3}$ of $\frac{3}{4}$ yd. = ? $\qquad$ $\frac{2}{3}$ of $\frac{3}{4} = \frac{2}{3} \times \frac{3}{4}$, or $\frac{6}{12}$.

To reduce $\frac{6}{12}$ to lower terms, both terms may be divided first by 3 and then by 2.

$$\frac{6}{12} = \frac{6 \div 3}{12 \div 3}, \text{ or } \frac{2}{4}. \quad \frac{2}{4} = \frac{2 \div 2}{4 \div 2}, \text{ or } \frac{1}{2}.$$

The part of a yard used was $\frac{1}{2}$.

This problem could have been solved more quickly by dividing by the 3 and then by the 2 (necessary in the reduction) before finding the product of the numerators and of the denominators.

$\frac{2}{3}$ of $\frac{3}{4}$ = ? $\qquad$ $\frac{2}{3}$ of $\frac{3}{4} = \frac{2}{3} \times \frac{3}{4}$.

Dividing a number in both numerator and denominator by crossing out, or canceling, the 3's, we have: $\frac{2}{\cancel{3}} \times \frac{\cancel{3}}{4}$.

Dividing a number in both numerator and denominator by 2, we have: $\frac{\cancel{2}}{\cancel{3}} \times \frac{\cancel{3}}{\cancel{4}_{2}}$, or $\frac{1}{2}$.

This short method of multiplying is called **cancellation.**

In cancellation, as in the reduction of a fraction to lower terms, always divide both the numerator and the denominator by the *same number*.

Explain how the answer to the following problem was found: $\frac{1}{3} \times \frac{15}{2} \times \frac{6}{7} = ?$

$$\frac{1}{\cancel{3}} \times \frac{\overset{3}{\cancel{15}}}{\cancel{2}} \times \frac{\overset{3}{\cancel{6}}}{7} = \frac{3 \times 3}{7} = \frac{9}{7}, \text{ or } 1\tfrac{2}{7}.$$

In dividing, notice that when a quotient is 1 it is not usually written. In taking $\frac{1}{3}$ of $\frac{6}{7}$, we think $\frac{1}{\underset{1}{\cancel{3}}} \times \frac{\overset{2}{\cancel{6}}}{7} = \frac{2}{7}$, but we write only $\frac{1}{\cancel{3}} \times \frac{\overset{2}{\cancel{6}}}{7} = \frac{2}{7}$.

[With pencil.]

Find products, canceling when possible:

1. $\frac{3}{5}$ of $\frac{6}{7}$ = ?
2. $\frac{3}{4}$ of $\frac{8}{15}$ = ?
3. $\frac{3}{5}$ of 15 = ?
4. $\frac{3}{5}$ of $\frac{5}{6}$ = ?
5. $\frac{3}{5} \times \frac{15}{18}$ = ?
6. $\frac{3}{5} \times \frac{10}{21}$ = ?
7. $18 \times \frac{3}{9}$ = ?
8. $24 \times \frac{3}{4}$ = ?
9. $40 \times \frac{5}{8}$ = ?
10. $\frac{3}{7} \times 63$ = ?
11. $\frac{5}{6} \times 120$ = ?
12. $\frac{7}{8} \times 160$ = ?
13. $\frac{2}{3} \times \frac{3}{4} \times \frac{4}{5}$ = ?
14. $\frac{8}{21} \times \frac{7}{15} \times \frac{9}{11}$ = ?
15. $12 \times \frac{2}{3} \times \frac{4}{5}$ = ?
16. $\frac{3}{4} \times \frac{3}{5} \times 20$ = ?
17. $45 \times \frac{3}{9} \times \frac{4}{15}$ = ?
18. $\frac{5}{18} \times \frac{11}{60} \times 24$ = ?

44. Review

I

[Use pencil only when needed.]

Use each of the following pairs of fractions for addition, for subtraction, and for multiplication:

1. $\frac{3}{4}$, $\frac{1}{4}$.
2. $\frac{3}{8}$, $\frac{1}{8}$.
3. $\frac{3}{8}$, $\frac{1}{4}$.
4. $\frac{1}{2}$, $\frac{3}{5}$.
5. $\frac{1}{2}$, $\frac{1}{6}$.
6. $\frac{3}{8}$, $\frac{1}{4}$.
7. $\frac{3}{4}$, $\frac{1}{8}$.
8. $\frac{5}{6}$, $\frac{1}{3}$.
9. $\frac{1}{2}$, $\frac{5}{12}$.
10. $\frac{7}{12}$, $\frac{1}{4}$.

Find answers:

11. $9\frac{7}{8} + \frac{3}{8}$ = ?
12. $4\frac{5}{16} + 3\frac{7}{16}$ = ?
13. $8\frac{2}{3} + 4\frac{1}{6}$ = ?
14. $7\frac{3}{10} + 5\frac{1}{2}$ = ?
15. $9\frac{3}{4} + 6\frac{3}{8}$ = ?
16. $8\frac{1}{5} + 6\frac{2}{3}$ = ?
17. $4\frac{5}{6} + 3\frac{3}{4}$ = ?
18. $5\frac{1}{2} + 3\frac{1}{4} + 2\frac{1}{8}$ = ?
19. $2\frac{5}{6} + 3\frac{1}{2} + 2\frac{1}{4}$ = ?
20. $17\frac{5}{16} - 9$ = ?
21. $14 - 3\frac{7}{11}$ = ?
22. $30 - 18\frac{2}{3}$ = ?
23. $8\frac{7}{8} - 4\frac{3}{8}$ = ?
24. $16\frac{2}{3} - 9\frac{1}{2}$ = ?
25. $15\frac{4}{5} - 7\frac{1}{3}$ = ?
26. $20\frac{5}{8} - 3\frac{1}{3}$ = ?
27. $18\frac{1}{8} - 6\frac{5}{8}$ = ?
28. $24\frac{1}{4} - 14\frac{3}{8}$ = ?
29. $\frac{5}{16} \times \frac{4}{5}$ = ?
30. $\frac{2}{3} \times \frac{7}{16}$ = ?
31. $\frac{3}{4} \times 128$ = ?
32. $\frac{4}{5} \times 75$ = ?
33. $84 \times \frac{2}{3}$ = ?
34. $25 \times \frac{3}{4}$ = ?
35. $15 \times \frac{5}{8}$ = ?
36. $320 \times \frac{7}{8}$ = ?
37. $150 \times \frac{3}{4}$ = ?

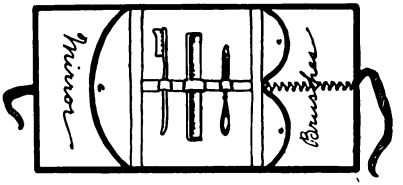
*38. Multiply $\frac{5}{12} + \frac{3}{8}$ by $\frac{3}{8}$ of 24.

*39. Subtract $\frac{3}{8}$ of 20 from $\frac{4}{5}$ of 18.

II. Making Christmas Presents

[Use pencil only when needed.]

1. Fred is to make two kodak books for Christmas presents. The cover for one requires $\frac{1}{4}$ of a yard of linen; the cover for the other, $\frac{5}{8}$ of a yard. Find the cost of the linen at 80¢ a yard.



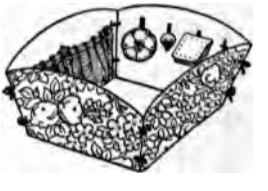
2. The boy's travel case pictured here requires $\frac{5}{16}$ of a yard of canvas of a given width, and 1 roll of braid. How much must be paid for the material if 48¢ a yard is paid for the canvas and 5¢ a roll for the braid?

3. Six calendars are to be tied with silk cord. How many yards are required if $\frac{5}{8}$ of a yard is used for each?

4. From a piece of muslin containing 10 yards, $1\frac{1}{4}$ yards are used for one apron and $2\frac{1}{2}$ yards for another. How many yards are there left in the piece?

5. Eight candy boxes are to be made. How many sheets of cardboard are required for the boxes if $\frac{1}{4}$ of a sheet is used for each?

6. The work box pictured here is covered with ribbon and lined with silk. Find the cost of the material when $\frac{2}{3}$ of a yard of ribbon is bought at 48¢ a yard and $\frac{3}{8}$ of a yard of silk at $1.60 a yard.



7. Elizabeth dresses 3 dolls for Christmas presents. For each doll she uses $\frac{3}{4}$ of a yard of muslin, $\frac{7}{8}$ of a yard of lace, and $\frac{2}{3}$ of a yard of ribbon. Find the amount of each material used.

*8. In buying material for Christmas presents, Margaret bought $\frac{7}{8}$ of a yard of silk at $1.25 a yard, $\frac{5}{16}$ of a yard of velvet ribbon at 80¢ a yard, and $\frac{1}{2}$ yard of silk braid at 30¢ a yard. Find the total cost.

45. The Mixed Number and the Integer in Multiplication

I

Pantry shelves are each to be $4\frac{3}{4}$ feet long. How long a board of the right width is required for 3 shelves?

$4\frac{3}{4}$ ft. multiplied by 3 = ?

$4\frac{3}{4}$	3 times $\frac{3}{4} = \frac{9}{4}$, or $2\frac{1}{4}$.
3	3 times 4 = 12.
$2\frac{1}{4}$	$2\frac{1}{4} + 12 = 14\frac{1}{4}$.
12	The length of the board required is $14\frac{1}{4}$ ft.
$14\frac{1}{4}$	

At 9¢ a foot, how much must be paid for $8\frac{2}{3}$ feet of picture molding?

9¢ multiplied by $8\frac{2}{3}$ = ?

9	$\frac{2}{3} \times 9 = 6$.
$8\frac{2}{3}$	$8 \times 9 = 72$.
6	$6 + 72 = 78$.
72	The cost of the molding is 78¢.
78	

To multiply a mixed number by an integer, or an integer by a mixed number: first, find the product of the fraction and the integer; next, find the product of the two integers; then, add the two products.

[Use pencil only when needed.]

1. Multiply $3\frac{1}{2}$ ft. by 4; $12\frac{1}{2}$ in. by 5; 6¢ by $2\frac{1}{2}$; 8¢ by $5\frac{1}{3}$; $2\frac{1}{4}$ gal. by 7.

2. What is the length of 2 strips of wood, each $16\frac{1}{2}$ inches long? Of 4 strips, each $12\frac{1}{4}$ inches long?

3. Pegs $5\frac{3}{4}$ inches long are to be made for garden markers. How long a strip of wood the width and thickness of the pegs is required for 12 pegs?

4. A boy purchases $2\frac{1}{2}$ lb. of nails at 9¢ a pound; $1\frac{3}{4}$ doz. screws at 8¢ a dozen; and $\frac{1}{2}$ of a pound of putty at 8¢ a pound. Find how much he owed.

Find the value of:

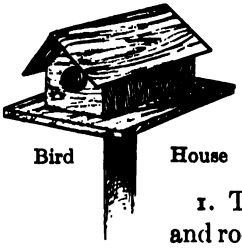
5. $2 \times 2\frac{1}{2}$.
6. $2 \times 3\frac{1}{3}$.
7. $3 \times 6\frac{1}{3}$.
8. $2 \times 1\frac{1}{4}$.
9. $3 \times 4\frac{1}{3}$.
10. $2 \times 12\frac{1}{2}$.
11. $4 \times 6\frac{1}{4}$.
12. $2 \times 33\frac{1}{3}$.
13. $1\frac{1}{2} \times 12$.
14. $1\frac{1}{3} \times 18$.
15. $2\frac{1}{2} \times 8$.
16. $1\frac{1}{4} \times 16$.
17. $3\frac{1}{3} \times 6$.
18. $2\frac{2}{3} \times 9$.
19. $8\frac{3}{4} \times 12$.

[With pencil.]

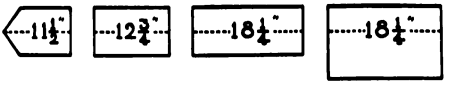
20. $3 \times 12\frac{1}{2}$.
21. $2 \times 16\frac{2}{3}$.
22. $3 \times 33\frac{1}{3}$.
23. $2 \times 37\frac{1}{2}$.
24. $8 \times 6\frac{1}{4}$.
25. $6 \times 16\frac{2}{3}$.
26. $5 \times 12\frac{1}{2}$.
27. $7 \times 42\frac{1}{2}$.
28. $2\frac{1}{2} \times 144$.
29. $8\frac{1}{4} \times 96$.
30. $3\frac{3}{4} \times 36$.
31. $2\frac{1}{3} \times 45$.
32. $2\frac{1}{3} \times 60$.
33. $6\frac{1}{6} \times 125$.
*34. $14\frac{1}{8} \times 360$.
*35. $19\frac{3}{7} \times 189$.

*36. Find the sum of $12\frac{1}{2} \times 7$ and $16\frac{2}{3} \times 5$.

II. In a Boy's Carpenter Shop



Bird House



Ends Sides Sides of Roof Floor

[Use pencil only when needed.]

1. The boards used in making the ends, sides, and roof of this bird house are each 8 inches wide. The board for the floor is $1\frac{1}{2}$ times as wide. What is its width?

Find the length of board required:

2. For the 2 end pieces, each $11\frac{1}{2}$ inches long.

3. For the 2 side pieces, each $12\frac{3}{4}$ inches long.

4. For the 2 sides to the roof, each $18\frac{1}{4}$ inches long.

5. What is the entire length in inches of the board required for the ends, sides, and roof? What is the entire length in feet?

6. A picture frame $16\frac{1}{2}$ inches long and $12\frac{1}{4}$ inches wide is to be made. How long a piece of molding is required for the 2 long sides of the frame? For the 2 short sides? What is the total length required?

7. At 12¢ a foot, how much must be paid for the molding for the picture frame, if $2\frac{1}{2}$ inches are allowed for waste?

*8. Find the cost, at 16¢ a foot, of molding for a picture frame $24\frac{1}{2}$ inches long and $18\frac{7}{8}$ inches wide. Allow $3\frac{1}{4}$ inches for waste.

46. The Mixed Number and the Fraction in Multiplication

(1) A piece of cloth $3\frac{1}{2}$ yards long is cut into 2 equal parts. How long is each piece?

$\frac{1}{2}$ of $3\frac{1}{2}$ yards = ?

$3\frac{1}{2} = \frac{7}{2}$. $\frac{1}{2} \times \frac{7}{2} = \frac{7}{4}$, or $1\frac{3}{4}$. $\frac{1}{2}$ of $3\frac{1}{2}$ yd. = $1\frac{3}{4}$ yd.

(2) A hair ribbon requires $1\frac{1}{4}$ yards of ribbon, a sash $2\frac{1}{2}$ times as much. How many yards of ribbon are required for the sash?

$2\frac{1}{2}$ times $1\frac{1}{4}$ yards = ?

$2\frac{1}{2} = \frac{5}{2}$. $1\frac{1}{4} = \frac{5}{4}$. $2\frac{1}{2} \times 1\frac{1}{4} = \frac{5}{2} \times \frac{5}{4} = \frac{25}{8}$, or $3\frac{1}{8}$.

The am't required = $3\frac{1}{8}$ yd.

In the multiplication of mixed numbers, or of mixed numbers and fractions, reduce the mixed numbers to improper fractions and then proceed as in the multiplication of fractions.

[With pencil.]

1. Multiply: $7\frac{1}{2}$ by $\frac{1}{5}$; $4\frac{1}{2}$ by $\frac{1}{3}$; $\frac{3}{4}$ by $3\frac{1}{3}$; $2\frac{1}{2}$ by $1\frac{1}{2}$; $3\frac{3}{4}$ by $1\frac{1}{5}$.

2. A roll of matting containing $12\frac{3}{4}$ yards is cut into 3 equal lengths. How many yards are there in $\frac{1}{3}$ of the roll?

3. A piece of flowered cretonne $1\frac{1}{2}$ yards long is used to cover a couch pillow. A piece $4\frac{2}{3}$ times as long is to be used for a window seat. How many yards are used for the window seat?

4. The waist of Mildred's dress requires $1\frac{3}{4}$ yd.; the skirt, $2\frac{1}{2}$ times as much. How many yards are required for the entire dress?

Find the products:

5. $3\frac{1}{3} \times \frac{1}{5}$.
6. $2\frac{1}{4} \times \frac{1}{3}$.
7. $4\frac{1}{3} \times \frac{1}{11}$.
8. $6\frac{3}{7} \times \frac{3}{8}$.
9. $\frac{3}{8} \times 4\frac{1}{2}$.
10. $\frac{3}{5} \times 7\frac{1}{2}$.
11. $\frac{2}{7} \times 5\frac{5}{6}$.
12. $\frac{1}{16} \times 4\frac{4}{11}$.
13. $2\frac{1}{2} \times 2\frac{1}{2}$.
14. $3\frac{1}{3} \times 1\frac{1}{3}$.
15. $4\frac{1}{8} \times 2\frac{3}{11}$.
16. $5\frac{1}{7} \times 1\frac{5}{8}$.
17. $14\frac{3}{8} \times 3\frac{6}{11}$.
*18. $16\frac{3}{8} \times 2\frac{1}{25}$.
*19. $17\frac{1}{3} \times 2\frac{1}{2}$.
*20. $24\frac{3}{8} \times 17\frac{1}{2}$.

II. In the Kitchen

[Use pencil only when needed.]

RECIPE FOR PLAIN CAKE

$1\frac{1}{2}$ cups of sugar
$\frac{1}{3}$ cup of butter
2 eggs
$1\frac{1}{4}$ cups of milk
2 teaspoons of baking powder
3 cups of flour
$1\frac{1}{2}$ teaspoons of vanilla

1. If you were to make a cake $\frac{1}{2}$ as large as the one for which the recipe above provides, how much of each ingredient would you need?

2. Halve these recipes:

CHOCOLATE FUDGE

2 cups sugar
$\frac{1}{4}$ cup of water
$\frac{3}{4}$ cup of milk
$\frac{1}{2}$ tablespoon of butter
1 square of chocolate

WALNUT CANDY

3 cups of sugar
$\frac{2}{3}$ cup of milk
1 teaspoon of vanilla
$\frac{3}{4}$ cup of walnuts

3. Double these:

VANILLA ICE CREAM	COOKIES
$2\frac{1}{2}$ cups of cream	$1\frac{1}{2}$ cups of sugar
$1\frac{1}{2}$ cups of milk	$\frac{3}{4}$ cup of butter
3 eggs	1 egg
1 cup of sugar	$\frac{3}{4}$ cup of milk
2 teaspoons of vanilla	$3\frac{3}{4}$ cups of flour

*4. Give a recipe for $1\frac{1}{2}$ times the amount provided for in the recipe for chocolate fudge. Give one for $\frac{2}{3}$ of that provided for in the recipe for walnut candy.

47. Test and Graded Practice

This test is to help you find out and overcome your difficulties in the multiplication of fractions. If you fail to get the right answer to a problem in the test, practice solving the problems in the set below having the same letter, then try the problem again.

Test No. 13.

A. $8 \times 2\frac{1}{5} = ?$ B. $2\frac{2}{3} \times 7 = ?$ C. $12\frac{1}{2} \times 2\frac{1}{3} = ?$

PRACTICE

Do work indicated:[1] [Copy problems only when necessary.]

A.		B.	
1. $3 \times \frac{3}{7}$.	5. $3 \times 4\frac{1}{5}$.	10. $\frac{3}{4} \times 12$.	14. $4\frac{1}{3} \times 2$.
2. $5 \times \frac{3}{5}$.	6. $8 \times 1\frac{1}{4}$.	11. $\frac{2}{3} \times 10$.	15. $8\frac{3}{4} \times 4$.
3. $6 \times \frac{7}{8}$.	7. $6 \times 2\frac{2}{3}$.	12. $\frac{5}{6} \times 20$.	16. $5\frac{3}{8} \times 3$.
4. $48 \times \frac{11}{12}$.	8. $16 \times 2\frac{7}{8}$.	13. $\frac{4}{5} \times 21$.	17. $2\frac{2}{3} \times 8$.
	9. $12 \times 3\frac{3}{5}$.		18. $4\frac{3}{4} \times 5$.

[1] Pupils needing further practice will find problems of the types included under A and B on pages 65 and 70. The types included under C are on pages 64 and 72. In solving the problems, pupils should reduce the mixed numbers to improper fractions only when it is more convenient to do so.

C.

19. $\frac{1}{2} \times \frac{1}{3}$.

20. $\frac{3}{5} \times \frac{3}{4}$.

21. $\frac{2}{3} \times \frac{5}{6}$.

22. $1\frac{1}{2} \times \frac{3}{5}$.

23. $1\frac{1}{3} \times \frac{5}{8}$.

24. $2\frac{1}{2} \times \frac{4}{15}$.

25. $2\frac{3}{5} \times \frac{5}{12}$.

26. $\frac{1}{4} \times 3\frac{1}{3}$

27. $\frac{2}{3} \times 3\frac{3}{4}$.

28. $\frac{7}{12} \times \frac{4}{7}$.

29. $\frac{3}{4} \times 1\frac{1}{3}$.

30. $1\frac{1}{4} \times 1\frac{3}{5}$.

31. $2\frac{3}{5} \times 1\frac{7}{8}$.

32. $3\frac{3}{8} \times 2\frac{1}{3}$.

33. $4\frac{1}{3} \times 3\frac{1}{2}$.

48. Fitting Up a Play Room

[With pencil.]

Robert and Helen fitted up a play room. Robert put up shelves for books and made two small cupboards in which to store games and toys. Helen made the curtains and cushions for the room.

1. Each book shelf was $3\frac{2}{3}$ feet long. How long a piece of lumber was required for the 3 shelves?

2. Robert used $18\frac{1}{2}$ feet of lumber in making each of the cupboards. How many feet did he use for the two?

3. For window curtains, Helen cut a piece of muslin 10 yards long into 4 equal pieces. What was the length of each piece.

4. Helen had 8 yards of flowered cretonne, which she used for cushions. Each cushion required $1\frac{1}{3}$ yards of goods. After covering 4 cushions how many yards were left?

5. Robert and Helen covered the floor of their play room with matting, using in all 4 strips each $3\frac{2}{3}$ yards long. Estimate, and then find, the number of yards that were used.

*6. The children bought 8 yards of denim. From this piece they cut 2 curtains each $1\frac{3}{8}$ yards long for one cupboard, and one curtain $1\frac{3}{4}$ yards long for the other cupboard. How many yards were left?

49. Taking Care of Pets

[Use pencil only when needed.]

1. John built a pen for his rabbits. He enclosed a square $1\frac{3}{4}$ yards on a side with wire netting. Find the number of yards he required.

2. Fred built a kennel for his Newfoundland dog. He used 60 feet of lumber at 15¢ a foot, $1\frac{1}{4}$ pounds of wire nails at 8¢ a pound, and $\frac{3}{4}$ of a quart of paint at 60¢ a quart. Find the cost of the materials used.

3. Margaret made a blanket for her Boston terrier. She bought $\frac{3}{4}$ of a yard of gray flannel at $1.20 a yard, and $3\frac{1}{2}$ yards of braid at 10¢ a yard. How much did the materials cost?

4. Five cents' worth of liver lasts Elizabeth's cat two days. At this rate, how much does the liver cost per week?

5. Fred spends a quarter of a dollar a week for meat for his dog. First estimate, then find, the cost of the meat per year.

6. Robert feeds his bantams $\frac{3}{4}$ of a pound of grain a day. At this rate, how much more than a bushel of grain weighing 60 pounds do the bantams eat in 3 months, or 90 days?

*7. When grain sells at $1.80 a bushel, how much does the grain for the bantams cost per day?

*8. Ruth's pony eats in 1 year $1\frac{1}{4}$ tons of hay and 23 bushels of oats. When hay is $32 a ton, and oats sell for $.90 a bushel, how much does this food cost per year? Per week?

50. Problem Test [1]

[Without pencil.]

1. What is the value in cents of 1 quarter, 1 dime, 5 nickels, and 8 cents?

2. How much change should be received from 50¢ in buying 3 dishes of ice-cream at 15¢ a dish?

3. At a bargain sale, games were marked at 22¢ apiece. Elizabeth bought "Corner Grocery," "Who?" and "Old Maid." How much did the games cost?

4. Glass beads were selling at 15¢ a box. Margaret bought 4 boxes. How much change should she have received from $1.00?

[1] See footnote page 25.

5. A toy merchant bought dolls for 18¢ apiece and sold them for 25¢ apiece. How much money did he make by selling 1 dozen dolls?

6. A grocer buys oranges at 30¢ a dozen and sells them at 40¢ a dozen. How many dozen must he sell to gain $1.00?

7. Candy is selling at 40¢ a pound. How much must be paid for $2\frac{1}{2}$ pounds?

8. Find the cost of $4\frac{1}{2}$ yards of lace at 10¢ a yard. Of $1\frac{3}{4}$ yards of lawn at 40¢ a yard. Of $3\frac{2}{3}$ yards of cord at 6¢ a yard.

9. How many yards of muslin must be bought for 2 curtains, if each takes $3\frac{1}{2}$ yards? For 3 stand covers, if each takes $1\frac{1}{3}$ yards?

10. Helen is to make one apron requiring $2\frac{1}{4}$ yards of cloth and another requiring $1\frac{3}{4}$ yards. How many yards does she need?

11. Robert cuts $3\frac{3}{4}$ yards of canvas from a piece 6 yards long. How many yards are left in the piece?

12. Margaret cuts $2\frac{1}{4}$ yards of lace from a piece $4\frac{1}{2}$ yards long. Find the number of yards left.

13. At the rate of a half-dollar apiece, how many neckties can be bought for $1.50? For $2.00?

14. How many yards of ribbon are needed for 2 hair ribbons each $1\frac{1}{2}$ yards long? For 4 hair ribbons?

15. A recipe for candy calls for $1\frac{1}{2}$ cups of sugar. How many cupfuls are required, if the recipe is doubled?

[With pencil.]

16. Saving money at the rate of 15 cents a day, in how many days could I save enough to buy a camera for $3.60 and a fountain pen for $1.25?

17. A ten-dollar bill is used in paying for a sweater bought for $6.75 and for a cap costing 75¢. How much change should be received?

18. Mr. Adams, a skilled workman, earns $6.50 a day. Mr Thomas, an unskilled workman, receives $4.50. Find the difference in their earnings for a month of 26 working days.

51. Progress Score

With the help of these exercises measure your work for the half year. The number of points to be counted for each correct answer is printed below the letter of the problem. Try to make a record of 100 points on each exercise, or a total of 400 points.

I. Add: [Copy problems only when necessary.]

A. $\frac{5}{8}$ (8) $\underline{\frac{1}{8}}$

B. $\frac{3}{4}$ (9) $\underline{\frac{3}{4}}$

C. $\frac{5}{12}$ (9) $\underline{\frac{1}{3}}$

D. $\frac{3}{8}$ (10) $\underline{\frac{1}{6}}$

E. 4 (6) 2 7 6 5 6 7 4 5

F. 327 (10) 544 363 506 729 568 789 858

G. $6\frac{1}{6}$ (9) $\underline{2\frac{2}{6}}$

H. $5\frac{1}{12}$ (12) $\underline{2\frac{1}{4}}$

I. $8\frac{1}{4}$ (12) $\underline{7\frac{5}{6}}$

J. Write in a column and find answer:

(15) \$4.75 + \$8.64 + 24¢ + \$6.15 + \$27 = ?

II. Subtract:

A. 7249 (7) $\underline{864}$

B. \$40.00 (8) $\underline{12.36}$

C. $\frac{4}{5}$ (5) $\underline{\frac{1}{5}}$

D. $\frac{7}{16}$ (7) $\underline{\frac{1}{16}}$

E. $\frac{5}{6}$ (10) $\underline{\frac{1}{3}}$

F. $\frac{3}{4}$ (12) $\underline{\frac{1}{3}}$

G. $14\frac{2}{3}$ (5) $\underline{9}$

H. 16 (12) $\underline{3\frac{1}{5}}$

I. $12\frac{7}{8}$ (10) $\underline{4\frac{1}{8}}$

J. $16\frac{3}{4}$ (9) $\underline{8\frac{1}{2}}$

K. $24\frac{1}{4}$ (15) $\underline{12\frac{1}{3}}$

III. Multiply:

A. $20 \times \frac{3}{4}$. (8)

B. $\frac{2}{3} \times 10$. (10)

C. $\frac{7}{8} \times \frac{3}{5}$. (10)

D. $3\frac{1}{3} \times 4\frac{1}{5}$. (15)

E. 729×203. (10)

F. \$2.46 × 281. (20)

G. $12\frac{1}{2}$ (12) $\underline{5}$

H. 24 (15) $\underline{2\frac{3}{4}}$

IV. Divide:

A. 4)\$25.00 (10)

B. 9)58943 (15)

C. 81)61074 (15)

D. 59)40120 (20)

E. 48)19536 (20)

F. 675)37800 (20)

CHAPTER V. GEOGRAPHY AND TRAVEL

52. The Use of Large Numbers

I

In order to express many facts in geography, it is necessary to know how to use large numbers. If, for example, we wish to write the number of square miles in the surface of the earth, we must use a number in the millions.

The surface of the earth contains about one hundred ninety-six million, nine hundred forty thousand square miles. The area is written in figures: 196,940,000 square miles.

Large numbers are divided into periods of three figures each:

Millions	Thousands	Units
196	940	000

1. Give the name of each period, beginning at the right.

In reading large numbers, the figures in each period are given the name of the period in which they are written, with the exception of those in units' period, where the word *units* is understood but not expressed.

35742 is read: thirty-five thousand, seven hundred forty-two.
64,040,008 is read: sixty-four million, forty thousand, eight.

Read:

2.	3.	4.
7000	1,000,000	1,421,642
25,420	32,000,000	107,427,318
142,000	225,000,000	17,006,435
308,040	104,000,000	407,040,003

Write in figures:

5. Four thousand.
6. Thirteen thousand.
7. Thirty thousand.
8. Three million.
9. Seventy million.
10. Three hundred million.
11. Two hundred twelve million.
12. One hundred four thousand, three hundred.
13. Two hundred forty thousand, one hundred sixty.
14. Two hundred forty thousand, sixty.
15. Five hundred one thousand, three hundred twenty-nine.
16. Five hundred one thousand, twenty-nine.
17. One million, seven hundred eighty thousand.
18. One million, eighty thousand.
19. Six million, forty thousand.
20. Four hundred million, four hundred thousand.

II

Not only are numbers divided into periods, but each period is divided into orders. The following table gives the order names for numbers containing three periods:

MILLIONS			THOUSANDS			UNITS		
Hundred-millions	Ten-millions	Millions	Hundred-thousands	Ten-thousands	Thousands	Hundreds	Tens	Units
2	4	5 ,	4	7	0 ,	3	0	5

1. Learn these order names from the right to the left, if you do not already know them.

Counting from the right, the number 245, 470, 305 is made up of 5 units, 0 tens, 3 hundreds, 0 thousands, 7 ten-thousands, 4 hundred-thousands, 5 millions, 4 ten-millions, 2 hundred-millions.

2. Read the numbers in the column under 4 on page 78, giving the place value, or order name, for each figure.

III

1. Read the facts in these tables:

THE AREA OF THE FIVE GREAT OCEANS

The Pacific	55,660,000	square	miles
The Atlantic	33,720,000	"	"
The Antarctic	30,605,000	"	"
The Indian	16,720,000	"	"
The Arctic	4,781,000	"	"

THE AREA OF THE FIVE GREAT CONTINENTS

North America	8,843,070	square	miles
South America	7,681,420	"	"
Europe	3,855,828	"	"
Asia with East Indies	16,770,951	"	"
Africa	11,508,793	"	"

2. Make a table from the following, writing each number in figures:

POPULATION OF MANKIND BY RACES

Red race, fifteen million.

Brown race, thirty-five million.

Black race, one hundred fifty million.

Yellow race, six hundred thirty million.

White race, six hundred ninety million.

3. Be ready to write from dictation other large numbers taken from your geographies.

53. The Zero in Multiplication and Division

I

$3 \times 10 = 30.$ $3 \times 100 = 300.$ $3 \times 1000 = 3000.$

1. What change is made in the value of the number 3 by placing a zero at the right? What change is made by adding two zeros? By adding three zeros?

2. How can you multiply a number by 10? By 100? By 1000?

3. How can you multiply a number by 40? By 300? By 2000?

Multiply: [Without pencil.]

4. 15 by 10.
5. 25 by 100.
6. 8 by 1000.
7. 20 by 10.
8. 20 by 100.
9. 20 by 1000.
10. 3 by 30.
11. 2 by 400.
12. 3 by 2000.

Multiply: [With pencil.]

13. 325 by 20.
14. 482 by 40.
15. 725 by 30.
16. 648 by 300.
17. 78 by 900.
18. 96 by 2000.
19. 304 by 400.
20. 87 by 6000.
21. $6.40 by 50.
22. $2.75 by 300.
23. $16.48 by 200.
24. $8.44 by 3000.

II

$$\begin{array}{r} 300 \\ 10\overline{)3000} \end{array} \qquad \begin{array}{r} 30 \\ 100\overline{)3000} \end{array} \qquad \begin{array}{r} 3 \\ 1000\overline{)3000} \end{array}$$

$3000 \div 10 = 300\emptyset$ $3000 \div 100 = 30\emptyset\emptyset$ $3000 \div 1000 = 3\emptyset\emptyset\emptyset$

1. How can a number ending in zeros be divided by 10? By 100? By 1000?

Divide: [Without pencil.]

2. 80 by 10.
3. 240 by 10.
4. 500 by 10.
5. 1000 by 10.
6. 2000 by 10.
7. 500 by 100.

8. 2000 by 100.
9. 8000 by 100.
10. 2400 by 100.
11. 10,000 by 100.
12. 7000 by 1000.
13. 48,000 by 1000.
14. 250,000 by 1000.
15. 500,000 by 1000.
16. 1,000,000 by 1000

III

At a cost of $200 per acre, how many acres of land can be bought for $1200? For $3000?

1200 + 200 = ?	3000 + 200 = ?
1200 + 200 = 12ØØ + 2ØØ.	3000 + 200 = 30ØØ + 2ØØ.
12 + 2 = 6.	30 + 2 = 15.

The same number of zeros may be struck off from both dividend and divisor without changing the value of the quotient.

Divide: [Use pencil only when needed.]

1. 1500 by 300.
2. 2400 by 200.
3. 480 by 20.
4. 6000 by 2000.
5. 5000 by 200.
6. 24,000 by 120.
7. 75,000 by 1500.
8. 90,000 by 3000.
9. 30,000 by 6000.
10. 150,000 by 500.
11. 70,000 by 200.
12. 48,000 by 2000.

13. At the rate of 60 miles an hour, how many hours does it take an airship to travel 240 miles?

14. A fast steamship traveled 500 miles a day. How long did it take to cover 3000 miles?

15. A freight car was built to carry 36,000 pounds. How many machines each weighing 400 pounds could it carry?

16. A barge had a cargo of 500,000 pounds of coal. How many tons of 2000 pounds each did it contain?

17. A ship carries 7000 tons of coal bought for $42,000. The cost was how much a ton?

18. A railway was built at a cost of $24,000 per mile. At that rate, how many miles of railway can be built for $2,400,000?

IV

Do work indicated: [With pencil.]

1. 68 × 600.	7. 781 × 6400.	13. 72540 ÷ 310.
2. 39 × 700.	8. 907 × 3500.	14. 135030 ÷ 210.
3. 78 × 900.	9. 765000 ÷ 500.	15. 171780 ÷ 420.
4. 69 × 800.	10. 976000 ÷ 800.	16. 341460 ÷ 640.
5. 567 × 2100.	11. 216000 ÷ 900.	17. 598320 ÷ 720.
6. 684 × 4300.	12. 126000 ÷ 700.	18. 462540 ÷ 780.

54. Speed and Accuracy Tests

Use these tests to measure your speed and accuracy with integers, or whole numbers. If, within the time limit, you fail to get the correct answers to all of the problems in a test, use for practice the problems of the same kind on pages 272–275, then try the test again.

[Copy problems only when necessary.]

Test No. 14. Add. Time limit, 3½ minutes.

A.	C.	D.
5476	6	287
3248	7	309
1305	5	677
4769	8	438
1327	0	276
	9	365
	6	730
B. 4325	4	239
13724	7	548
41756	6	
496	7	
3428	8	

Test No. 15. Subtract. Time limit, 40 seconds.

E. 13642	
7980	
F. 9000	
1327	
G. 86407	
5328	

Test No. 16. Multiply. Time limit, 2½ minutes.

H. 3971	I. 276	J. 608	K. 548
7	800	97	308

Test No. 17. Divide. Time limit, $5\frac{1}{2}$ minutes.

L.	M.	N.	O.
$7\overline{)34,361}$	$815\overline{)37,490}$	$49\overline{)41,650}$	$720\overline{)414,720}$

55. An Ocean Liner

[Use pencil only when needed.]

1. One of the largest steamships crossing the Atlantic is 790 feet long. Six such steamships put end to end would extend how much less than a mile.[1]

2. The steamship carries 500 first-class passengers, 500 second-class passengers, and 1300 third-class passengers. How many passengers does the ship carry in all?

3. In its crew, the officers and sailors number 70; the engineers and firemen number 390; the stewards, 350; and the cooks, 50. Counting the passengers and the crew, how many people does the ship carry?

4. For groceries, the ship carries on each voyage 250 barrels of flour weighing 196 pounds each, 20 tons of potatoes, 5 tons of sugar, $1\frac{1}{2}$ tons of coffee, $\frac{1}{2}$ ton of tea, $\frac{3}{4}$ of a ton of cheese, and $1\frac{1}{4}$ tons of soap. How many pounds of each article does the ship carry?

[1] To find the number of feet in a mile, see tables at the end of the book.

5. For poultry to be used on a six days' voyage, the ship carries 500 quail, 400 pigeons, 200 snipe, 90 geese, 150 turkeys, 350 ducks, and 2000 fowls. What is the total number of poultry carried?

6. The steamer burns 1000 tons of coal each day, when going at high speed. At that rate, how many tons of coal does she burn in a voyage lasting 5 days? If the ship carries 6600 tons of coal, how many tons has she left in her bunkers at the end of the voyage?

7. This ship has traveled 778 miles in one day. If she could keep this rate of speed for the entire voyage, how many days would it take her to cross the Atlantic by the route 3196 miles long?

8. With the help of the following table, many facts can be found out about the famous ships mentioned. It is interesting, for example, to see how many ships of the length of the Santa Maria could be put end to end on the deck of the Lusitania. It is interesting also to find how many years after the trial trip of the Clermont the Lusitania took the first five-day trip made across the Atlantic. Use the table for finding out these facts and others that interest you.

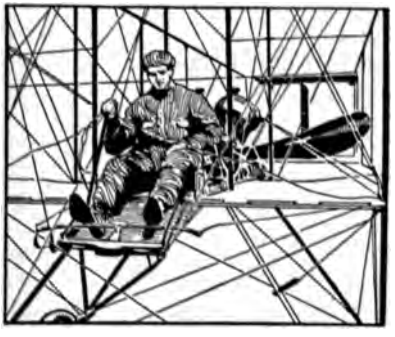
FAMOUS SHIPS

	Date of Famous Voyage	Ship's Length	Ship's Beam (width)
Santa Maria (Flagship in Columbus's Fleet)	1492	97 ft.	26 ft.
Half Moon (Henry Hudson's Ship)	1609	58½ ft.	16 ft.
Mayflower (Used by the Pilgrim Fathers)	1620	95 ft.	24 ft.
Clermont (Steamboat invented by Robert Fulton)	1807	150 ft.	13 ft.
Lusitania (First boat to cross the Atlantic in 5 days)	1907	790 ft.	88 ft.

56. Travel in an Airship

Before solving these problems, read them through and explain how each is to be done:

[Use pencil only when needed.]



1. The first ascent in an airship took place in 1903; the first great race, in 1910. How many years ago did each event take place?

2. One of the first long journeys in an airship in America was made across the United States from the Atlantic to the Pacific. The journey was made in 31 short trips, each trip averaging 130 miles. How long was this journey?

3. This first trip across the country took 82 hours of flying. In a recent race the winner was in the air 25 hours. This was how many hours less?

4. How many feet from the earth is an airship when it has ascended 6 miles?

5. During one of the record flights for height, an aviator went up 34,610 feet. This was how many feet over 6 miles?

6. At 2 miles a minute, how far can an airship go in an hour?

7. During one of the record flights for speed, the aviator traveled at the rate of 124 miles an hour for $5\frac{1}{4}$ hours. How far did he travel?

8. An airship traveling at the rate of 75 miles an hour takes how much time to cover a distance of 1500 miles? This time is how much less than that required by an express train to cover the same distance, traveling 60 miles an hour?

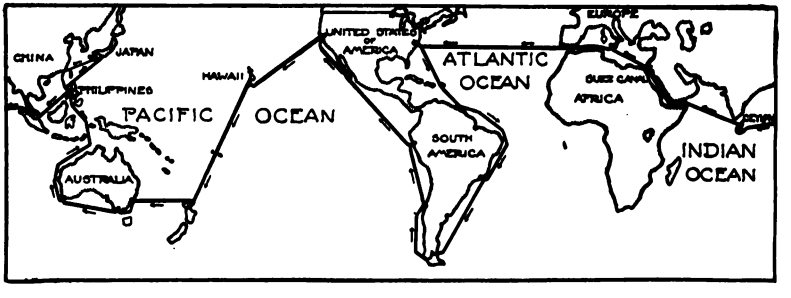
*9. At the rates given in the table on the next page, find the difference in the distance it is possible for the airship and the steamship to travel in 24 hours.

FAST RATES OF SPEED IN LONG-DISTANCE TRAVEL

Ocean liner	31	miles per hour.
Fast express	69	" " "
Airship	110	" " "

*10. Use the table for other problems.

57. Around the World



[With pencil.]

1. In 1907, sixteen of our warships made the first trip around the world ever made by ships of our navy. The first part of the voyage was from the United States Navy Yard in Maryland around South America to San Francisco. The distances covered between stops were: 1803 mi., 3399 mi., 2374 mi., 2838 mi., 3010 mi., and 1017 mi. First estimate, and then find, the distance traveled in this part of their journey.

2. The fleet next crossed the Pacific and visited Australia, Japan, China, and the Philippines. The distances covered in miles were: 2100, 3850, 1284, 575, 1350, 3300, 1750, 1343, and 666. Find the total number of miles covered in this part of its journey.

3. On the journey home, the fleet traveled from the Philippines to the Island of Ceylon, from Ceylon to the Suez Canal, and then through the Mediterranean Sea and across the Atlantic. The distances covered were, in miles: 2946, 3440, 1982, and 3200. Find

the entire distance covered by the fleet on its voyage around the world.

4. By going through the Panama Canal, it is possible for a ship to sail around the world, covering only 26,734 miles. The fleet traveled how much farther than this distance?

5. It took the fleet 1 year and 68 days to go around the world. How many days did it take?

6. Out of this time, 214 days were spent in different ports, coaling up and visiting cities. How many days were spent in actual travel?

*7. Counting the days spent in actual travel, what was the average rate of travel per day?

8. With the help of the table below, find the difference in the length of the "short travel" route around the world and the "all water" route.

DISTANCES AROUND THE WORLD

Circumference of the earth at the equator	24,902 miles
Circumference, encircling the North and South Poles	24,858 "
All-water route by way of Panama and Suez	26,734 "
Short-travel route by rail and steamship	26,121 "

*9. Make and solve other problems, using the table.

58. Problem Test [1]

[Without pencil.]

1. A load of hay weighs 3000 pounds. How much is the hay worth at $30 a ton?

2. At $6 a ton, how much must be paid for 200 tons of soft coal?

[1] In connection with this test and other similar ones throughout the book, questions may be asked covering the topics studied and both new and old types of problems. Such questions may be given as: What is a short way of multiplying a number by 300? Of dividing 8000 by 2000? How can you find the number of tons in 6000 pounds? See suggestion, also, in the footnote on page 25.

3. A long ton weighs 2240 pounds; a short ton, 2000 pounds. What is the difference in their weights?

4. A railway pays $50,000 for one new locomotive and $60,000 for another. How much is paid for the two?

5. At a cost of $20,000 apiece, how many day coaches can be built for $40,000?

[With pencil.]

6. The government at Washington bought 15 airships at a cost of $9500 apiece. How much did the airships cost?

7. A warship was purchased for $7,500,000. This sum of money would build how many miles of good roads if the cost of each mile was $1200?

8. The route taken by a vessel is 3196 miles long. The first day of her voyage she travels 450 miles; the second day, 495 miles; the third day, 512 miles. How many more miles has she to travel?

9. An airship traveling at the rate of 72 miles an hour covers what distance in $\frac{3}{4}$ of an hour?

10. A fast train traveling at the rate of $1\frac{1}{4}$ miles a minute makes a trip lasting 16 hours. What is the distance covered?

11. A steamer crossing the Atlantic in 6 days burns 640 tons of coal a day. At $5.50 a ton, how much does the coal for the voyage cost?

12. The distance from San Francisco across the Pacific Ocean to Hawaii is 2097 miles; from Hawaii to Japan, the distance is 3403 miles. Traveling at the rate of 300 miles a day, how many days are required by a steamship to cover the distance from San Francisco to Japan by way of Hawaii?

CHAPTER VI. UNITED STATES MONEY AND OTHER DECIMALS

59. The Mill in United States Money

Manufacturers and other business men keep such careful account of expenses that, in recording the cost of a small article, even the fractional part of a cent is reckoned. The smallest part used is one tenth of a cent, called a **mill.**

In writing sums of money, the third place to the right of the decimal point is used for mills.

$\frac{1}{10}$ of a cent is written \$.001, and read 1 mill.

$\frac{3}{10}$ of a cent is written \$.003, and read 3 mills.

$\frac{1}{2}$, or $\frac{5}{10}$, of a cent is written \$.005, and read 5 mills.

$3\frac{7}{10}$ cents is written \$.037, and read 3 cents 7 mills.

$25\frac{3}{10}$ cents is written \$.253, and read 25 cents 3 mills.

1. Read:

\$.06	\$.04	\$2.78	\$214.04
\$.006	\$.049	\$2.785	\$76.435
\$.07	\$.064	\$4.258	\$8.007
\$.073	\$.005	\$7.08	\$25.665
\$.009	\$.275	\$7.083	\$143.027
\$.05	\$.085	\$7.283	\$104.054
\$.053	\$.805	\$7.203	\$104.501

In writing sums of money in which no dollars occur, it sometimes adds to the clearness if a cipher is written at the left of the decimal point. For example, if \$.48 is to be used in a place where it might be mistaken for \$48, it is written \$0.48.

2. Read:

Manufacturing Cost of a Sweater selling for $4.50

Wool	$1.744
Winding	.072
Knitting	.098
Finishing	.238
Other Expenses	.312
Total	$2.464

Manufacturing Cost of a Pair of Seven-Dollar Shoes

Leather	$3.754
Findings	.696
Cutting	.22
Stitching	.24
Lasting	.114
Bottoming	.246
Finishing	.12
Other Expenses	.252
Total	$5.642

3. Write with dollar signs:

4 mills.	2 dollars 8 cents 3 mills.
5 cents 3 mills.	1 dollar 9 mills.
9 cents 7 mills.	5 dollars 87 cents 2 mills.
16 cents 5 mills.	10 dollars 5 cents 5 mills.
75 cents 6 mills.	30 dollars 75 cents 9 mills.
20 cents 5 mills.	25 dollars 40 cents 9 mills.

60. Addition and Subtraction of United States Money

What is the sum of $4.20 and $2.248? What is their difference?

$4.20 + $2.248 = ?

$$\begin{array}{r} \$4.20 \\ 2.248 \\ \hline \$6.448 \end{array}$$

$4.20 − $2.248 = ?

Think:
$$\begin{array}{r} \$4.200 \\ 2.248 \\ \hline \$1.952 \end{array}$$

Write:
$$\begin{array}{r} \$4.20 \\ 2.248 \\ \hline \$1.952 \end{array}$$

1. In writing sums of money for addition and subtraction, how should the numbers be placed with reference to the decimal points? Why is this done?

2. How many places are pointed off in an answer, in adding or subtracting sums of money in which mills occur?

Add: [With pencil.]

3. \$2.84, \$3.145, \$4.025, \$1.038, \$2.75.

4. \$.028, \$.085, \$.25, \$.78, \$.052.

5. \$0.125, \$0.375, \$5.87, \$8.42.

6. \$4.85, \$6.375, \$5.00, 75¢, \$.875, \$.625.

7. \$0.60, 98¢, \$0.25, \$0.178, \$1.25, \$8.

Subtract:

8. \$1.25 from \$5.00.
9. \$2.98 from \$10.00.
10. 95¢ from \$2.
11. \$.025 from \$.048.
12. \$.028 from \$.05.
13. \$.875 from \$1.00.
14. \$.015 from \$.20.
15. \$.003 from 3¢.
16. \$.075 from 10¢.

61. Multiplication of United States Money

How much must be paid for 9 yards of muslin at \$.15 a yard? At \$.125 a yard?

\$.15 × 9 = ?	\$.125 × 9 = ?
\$.15 9 \$1.35	\$.125 9 \$1.125
Am't to be paid = \$1.35.	Am't to be paid = \$1.13.

1. In the solutions above, how many places were pointed off in the first product? In the second product?

Since it is not possible to pay with coins a sum of money less than a cent, it is customary to call any number of mills from 5 mills to 9, a full cent. In paying a bill for \$1.125, the amount given is \$1.13.

Four mills or less are not counted. For example, \$.044 is called \$.04, and \$2.023 is called \$2.02.

[With pencil.]

2. At \$.065 a foot, how much must be paid for 7 feet of picture molding?

3. Closet hooks are selling at \$.025 apiece. How much must be paid for 15 hooks?

4. Coat hangers are selling at $.075 apiece. Find the cost of 9.

5. $.375 × 3 = ?
6. $.035 × 7 = ?
7. $.758 × 5 = ?
8. $1.025 × 5 = ?
9. $2.028 × 14 = ?
10. $0.254 × 3 = ?
11. $1.024 × 6 = ?
12. $0.255 × 21 = ?
13. $0.875 × 40 = ?

62. Division of United States Money

I

What is $\frac{1}{3}$ of $9.12? Of $6.075?

$\frac{1}{3}$ of $9.12 = $9.12 ÷ 3.

$$\begin{array}{r} \$3.04 \\ 3\overline{)\$9.12} \end{array}$$

$\frac{1}{3}$ of $9.12 = $3.04.

$\frac{1}{3}$ of $6.075 = $6.075 ÷ 3.

$$\begin{array}{r} \$2.025 \\ 3\overline{)\$6.075} \end{array}$$

$\frac{1}{3}$ of $6.075 = $2.025.

1. In finding $\frac{1}{3}$ of $9.12, how many places were pointed off in the quotient for cents?

2. In finding $\frac{1}{3}$ of $6.075, how many places were pointed off in the quotient? Why?

[Use pencil only when needed.]

3. Three boys buy a rowboat for $30.75, sharing the expense equally. Find how much each boy has to pay.

4. A Christmas present of $5.50 is divided equally between two sisters. How much is given to each?

5. Margaret buys $\frac{1}{3}$ of a yard of velvet at $5.49 a yard and $1\frac{1}{3}$ yards of lining at $.375 a yard. How much does she owe the merchant?

6. $\frac{1}{2}$ of $3.50 = ?
7. $\frac{1}{4}$ of $9.00 = ?
8. $\frac{1}{8}$ of $16.00 = ?
9. $\frac{1}{5}$ of $50.00 = ?
10. $\frac{1}{6}$ of $75.00 = ?
11. $\frac{1}{2}$ of $.026 = ?
12. $\frac{1}{8}$ of $.375 = ?
13. $\frac{1}{7}$ of $.875 = ?
14. $\frac{1}{2}$ of $1.628 = ?
15. $\frac{1}{4}$ of $9.124 = ?
16. $7.20 ÷ 4 = ?
17. $45.75 ÷ 15 = ?
18. $1.625 ÷ 5 = ?
19. $8.028 ÷ 4 = ?
20. $7.775 ÷ 25 = ?

II

How can you find how many times 25 cents is contained in $1.00? 5 cents in $1.25?

In dividing one sum of money by another, it is necessary to express both sums as like quantities. In dividing 1 dollar by 25 cents, we divide either 100 cents by 25 cents, or $1 by $$\frac{1}{4}$$. In dividing $1.25 by 5 cents, we divide either 125 cents by 5 cents, or $1.25 ($1\frac{25}{100}$ dollars) by $.05 ($\frac{5}{100}$ dollars).

At 75¢ apiece, how many library books can be bought for $30?

$30 ÷ 75¢ = $30.00 ÷ $.75.

```
        40
$.75 | $30.00
       300
         0
```

No. of books = 40.

Notice that, in dividing $30 by 75¢, the numbers are both written with a dollar sign and with two figures at the right of the decimal point. Why is this done?

In what other way might the two sums of money have been written?

[With pencil.]

1. Express as like quantities: $2.25 and 25¢; 68¢ and $4; 45¢ and $5; $5.25 and 8¢; 42¢ and $20.

First express as like quantities, and then divide:

2. $5.75 by 5¢.
3. $2.88 by 6¢.
4. $7.52 by 4¢.
5. $5 by 8¢.
6. $30 by 15¢.
7. $75 by 25¢.
8. $30 by 60¢.
9. $8 by 40¢.
10. $60 by 75¢.

III. Saving Money

[With pencil.]

1. A phonograph is advertised for sale for $35. At the rate of 25¢ a day, how many days will it take to save money enough to buy it?

2. Find the length of time required, at the rate of 5¢ a day, to save $2.25. To save $4.

3. Robert has saved $4.25 toward the cost of a work bench with a set of tools advertised for sale for $22.25. At the rate of 75¢ a week, how many weeks will it take him to save the rest of the money?

4. Helen wishes to save $6 for the expenses of a trip to her aunt's. How many more weeks will it take her to save the money at the rate of 25¢ a week than at the rate of 75¢ a week?

5. Think of something that you would like to buy. Find out its price, and then find how long it would be before you could buy it if you were to save 15¢ a week.

6. Make and solve two other problems about saving money.

63. Boys and Girls in Business

[With pencil.]

1. Robert and Helen had a lemonade stand. They bought 1½ dozen lemons at the rate of 5¢ apiece, 5 pounds of sugar at $.11 a pound, and 1 cake of ice at 10¢; then they made 12 quarts of lemonade, which they sold at 5¢ a glass. A glass holds ½ pint. How much did they receive for their lemonade? What was their profit?

2. Fred Martin and three of his friends decided to buy a radiopticon. They planned to earn money for it by giving three evening entertainments, using a magic lantern. The boys bought ½ dozen lantern slides at $1.75 a dozen, and spent 8¢ for oil, 10¢ for tickets, and 50¢ to have their tent repaired. How much money did the boys spend?

3. The boys charged 10¢ admission. For the first evening, the boys sold 32 tickets; for the second evening, 25 tickets; for the third, 27 tickets. What sum of money was received from the sale of tickets?

4. How much money did the boys have left from the sale of tickets after paying expenses and buying a six-dollar radiopticon?

5. Gertrude and Ruth Deane made peanut candy, which they sold at 35¢ a box, and chocolate candy, which they sold at 40¢ a box. For each box of peanut candy, their expenses were: for 1 pound of sugar, $.115; for shelled peanuts, $.10; for butter, $.045. The profit on each box of peanut candy was how much?

6. For each box of chocolate candy, the girls used 1½ lb. of brown sugar at $.10 a pound; ¼ cake of chocolate at $.28 a cake; a tablespoon of butter, $.045; ½ cup of milk, $.02; and 2 teaspoons of vanilla, $.02. How much did the chocolate candy cost a box? How much profit was made on each box?

*7. The girls made 12 boxes of peanut candy and 18 boxes of chocolate candy. Find their total profit.

64. The Meaning of a Decimal Fraction

UNITS, TENS, AND HUNDREDS	UNITED STATES MONEY
10 units = 1 ten	**10 mills = 1 cent**
10 tens = 1 hundred	**10 cents = 1 dime**
10 hundreds = 1 thousand	**10 dimes = 1 dollar**

1. What number is used in building the table of units, tens, and hundreds? What number is used in building the table of United States money?

Any plan based upon the number **ten** is called a **decimal**[1] plan.

[1] The word *decimal* is from the Latin word *decem*, meaning ten. We find this Latin word also in *December*, which was at one time the tenth month of the year.

2. What part of a dollar is 1 dime? 3 dimes? 7 dimes?

3. What part of a dollar is 1 cent? 11 cents?

4. What part of a dollar is 1 mill? 5 mills?

Such fractions as $\frac{1}{10}$, $\frac{3}{10}$, $\frac{7}{10}$, $\frac{1}{100}$, $\frac{11}{100}$, $\frac{1}{1000}$, $\frac{5}{1000}$ are decimal fractions written as common fractions.

The denominator of a decimal fraction must be 10, or a product of a number of tens. It may be 10; 10×10, or 100; $10 \times 10 \times 10$, or 1000; $10 \times 10 \times 10 \times 10$, or 10,000; or the product of some other number of tens.

Select the decimal fractions written as common fractions:

5. $\frac{7}{10}$, $\frac{5}{100}$, $\frac{3}{425}$.

6. $\frac{25}{100}$, $\frac{6}{200}$, $\frac{3}{10}$.

7. $\frac{5}{1000}$, $\frac{7}{700}$, $\frac{3}{400}$.

8. $\frac{9}{10}$, $\frac{21}{100}$, $\frac{5}{40}$.

9. $\frac{3}{500}$, $\frac{16}{1000}$, $\frac{3}{20}$.

10. $\frac{5}{12}$, $\frac{3}{500}$, $\frac{75}{100}$.

11. $\frac{58}{100}$, $\frac{44}{800}$, $\frac{9}{1000}$.

12. $\frac{11}{70}$, $\frac{45}{100}$, $\frac{3}{2000}$.

13. $\frac{25}{1000}$, $\frac{175}{900}$, $\frac{325}{1000}$.

65. Reading and Writing Decimals

In writing United States money:

$\frac{1}{10}$ of a dollar is written \$.10; $\frac{3}{10}$ of a dollar is written \$.30.

$\frac{1}{100}$ of a dollar is written \$.01; $\frac{25}{100}$ of a dollar is written \$.25.

$\frac{1}{1000}$ of a dollar is written \$.001; $\frac{5}{1000}$ of a dollar is written \$.005.

Decimal parts of other quantities may be written in the same manner:

$\frac{1}{10}$ of a mile may be written .10 miles, or .1 miles; $\frac{3}{10}$ of a mile may be written .30 miles, or .3 miles.

$\frac{1}{100}$ of a pound may be written .01 pounds; $\frac{25}{100}$ of a pound, .25 pounds.

$\frac{1}{1000}$ of a ton may be written .001 tons; $\frac{5}{1000}$ of a ton, .005 tons.

Fractions that have their denominators expressed are called **common fractions.**

$\frac{1}{2}$, $\frac{3}{4}$, $\frac{3}{10}$, $\frac{17}{100}$ are common fractions.

Fractions that have their denominators indicated by a decimal point are called **decimal fractions** or **decimals.**

.9, .02, .325 are decimals.

In writing decimals, one figure at the right of the decimal point expresses tenths, two figures express hundredths, and three express thousandths.

.9 is read nine tenths.
.09 is read nine hundredths.
.009 is read nine thousandths.
2.3 is read two and three tenths.
4.11 is read four and eleven hundredths.

In reading numbers, the word *and* is used only at the decimal point. The number 135.5 is read, one hundred thirty-five *and* five tenths.

Read:

1. .1, .01, .001.
2. .3, .7, .9.
3. .03, .09, .05.
4. .007, .003, .004.
5. .25, .37, .44.
6. .235, .162, .403.
7. .5, .25, .475.
8. 7.3, 6.4, 32.8.
9. 2.05, 7.03, 9.25.
10. 6.001, 4.002, 3.075.
11. 23.7, 14.3, 24.25.
12. .42, 2.75, 3.125.
13. 218.3, 412.02.
14. 3.217, 4.283.
15. 52.18, 154.225.

In writing decimals, use as many zeros as are necessary to give hundredths two places, thousandths three places.

Write as decimals:

16. $\frac{7}{10}$, $\frac{3}{10}$, $\frac{4}{10}$.
17. $\frac{25}{100}$, $\frac{75}{100}$, $\frac{34}{100}$.
18. $\frac{6}{100}$, $\frac{7}{100}$, $\frac{38}{100}$.
19. $\frac{320}{1000}$, $\frac{835}{1000}$.
20. $\frac{44}{1000}$, $\frac{68}{1000}$, $\frac{301}{1000}$.
21. $\frac{7}{100}$, $\frac{8}{100}$, $\frac{20}{100}$.
22. $\frac{9}{10}$, $\frac{9}{100}$, $\frac{9}{1000}$.
23. $\frac{6}{100}$, $\frac{6}{1000}$, $\frac{16}{1000}$.
24. $2\frac{3}{10}$, $4\frac{5}{10}$, $14\frac{7}{10}$.
25. $24\frac{68}{100}$, $5\frac{3}{100}$, $7\frac{8}{100}$.
26. $8\frac{7}{100}$, $5\frac{238}{1000}$, $6\frac{475}{1000}$.
27. $11\frac{3}{100}$, $4\frac{25}{1000}$.

66. Addition and Subtraction of Decimals

I

(1) A railway train covers, during the first hour of its run, 45.25 miles; during the second hour, 54.5 miles; and during the third hour, 51.125 miles. What is the distance covered?

The distance covered equals the sum of 45.25 mi., 54.5 mi., and 51.125 mi.

```
 45.25  mi.
 54.5    "
 51.125  "
150.875 mi.
```

The distance covered = 150.875 mi.

(2) What is the difference in the record of the train for the first and third hours?

The difference in the records equals 51.125 mi. − 45.25 mi.

```
51.125 mi.
45.25    "
 5.875 mi.
```

The difference in the records = 5.875 mi.

(3) What is the difference in the record of the train for the second and third hours?

The difference in the records equals 54.5 mi. − 51.125 mi.

```
Think: 54.500 mi.        Write: 54.5    mi.
       51.125  "               51.125  "
        3.375 mi.               3.375 mi.
```

The difference in the records = 3.375 mi.

Notice that in problem (3) the decimal places in the subtrahend exceed the number in the minuend and that ciphers are mentally supplied.

1. In the addition and subtraction of United States money, why are cents written under cents, and dollars under dollars?

2. In the addition and subtraction of other decimals, why are tenths written under tenths, hundredths under hundredths, and thousandths under thousandths?

In the addition and subtraction of decimals, all numbers should be written with their decimal points in the same vertical line.

[With pencil.]

Add:

3. $2.489	4. 17.64 mi.	5. .475 lb.	6. 940.
3.24	8.397 "	.36 "	84.27
42.8	2.96 "	2.842 "	6.248

Subtract:

7. $8.75	8. 9.125 ft.	9. 2.375 T.	10. 12.5 A.
2.48	4.021 "	1.25 "	4.24 "

11. Three machines are to be loaded on a car. The first weighs 1.75 tons; the second, .375 tons; and the third, 2.4 tons. What is their total weight?

12. Four loads of hay are to be put into a barn. The first load weighs 1.125 tons; the second, 1.75 tons; the third, 1.8 tons; the fourth, 1.9 tons. Find the weight of the four loads.

13. A wagon that, unloaded, weighs .25 tons weighs, when loaded with coal, 1.375 tons. What is the weight of its load?

II

[With pencil.]

Add:

1. .95, .8, .75, .24.
2. .052, .78, .124, .9, .32.
3. .6, .45, .8, .237, .38.
4. 2.345, 8.27, 6.824, 3.42.
5. 12.9, 64.8, 9.75, 2.44, 3.12.
6. 124.8, 327.25, 89.275.
7. .942, 5.84, 7.139, 9.8.
8. 16.24, .98, .275, 3.24.
9. 235.8, 47.9, 62.98, 321.5.
10. 84, 123, 75.5, 63.75, 8.375

Subtract:

11. .276 from .982.
12. .65 from .708.
13. .9 from 42.3.

14. 2.8 from 14.9.
15. 8.75 from 65.98.
16. 24.8 from 72.24.
17. .324 from .87.
18. 2.48 from 9.2.
19. 8.12 from 15.2.
20. 2.84 from 24.9.
21. 6.2 from 12.
22. 14.375 from 20.

67. Multiplication of Decimals

I

(1) What is the product of $\frac{1}{10}$ and $\frac{1}{10}$? Of .1 and .1?

$$\frac{1}{10} \times \frac{1}{10} = \frac{1}{100}. \qquad .1 \times .1 = .01.$$

1. In multiplying .1 by .1, how many decimal places are there in the multiplicand and the multiplier together? How many are there in the product?

(2) What is the product of $\frac{1}{10}$ and $\frac{1}{100}$ expressed decimally? Of $\frac{8}{10}$ and $\frac{8}{100}$?

$$\frac{1}{10} \times \frac{1}{100} = \frac{1}{1000}. \qquad .1 \times .01 = .001.$$

$$\frac{8}{10} \times \frac{8}{100} = \frac{9}{1000}. \qquad .3 \times .03 = .009.$$

2. Compare the number of decimal places in the product with the number in the multiplicand and multiplier together, in multiplying .1 by .01. In multiplying .3 by .03.

II

At the rate of 14.75 miles per hour, how far can a steamboat travel in three hours? In 4.5 hours?

14.75 mi. × 3 = ?

```
  14.75 mi.
      3
  -------
  44.25 mi.
```

Distance for 3 hr. = 44.25 mi.

14.75 mi. × 4.5 = ?

```
  14.75 mi.
    4.5
  -------
   7375
  5900
  -------
  66.375 mi.
```

Distance for 4.5 hr. = 66.375 mi.

In the multiplication of decimals, a number of places should be pointed off in the product equal to the sum of those in the multiplicand and the multiplier.

It is sometimes necessary to prefix one or more ciphers to make the required number of decimal places. Illustration: $.04 \times .2 = .008$.

[With pencil]

1. Multiply: .024 by 3; 2.21 by 4; 24.2 by .3; 3.21 by .2.

2. What is the weight of 4 loads of hay having an average weight of 1.42 tons?

3. A passenger train traveling at the rate of 45.5 miles per hour makes a trip in 2.5 hours. What is the distance covered?

4. A fast freight traveling at the rate of 35.8 miles per hour covers what distance in 1.5 hours?

5. An engine is to pull, besides its tender, 24 freight cars having an average weight of 34.25 tons. The tender weighs 25 tons. Find the weight of the load pulled by the engine.

Multiply:

6. 2.24 by 4.
7. 24.3 by 3.
8. .342 by 2.
9. 32.4 by .2.
10. 1.24 by .3.
11. 23.14 by 3.
12. 423.4 by 4.
13. 3.242 by 6.
14. .042 by 3.
15. .03 by .8.
16. 2.13 by 20.
17. 4.24 by 14.
18. 3.14 by 2.1.
19. .26 by .8.
20. 42.3 by .24.

68. Division of a Decimal by an Integer

1. What is $\frac{1}{2}$ of \$8.64? Of \$6.048?

2. How many places are pointed off in the quotient in finding $\frac{1}{2}$ of \$8.64? In finding $\frac{1}{2}$ of \$6.048?

How many miles are there in $\frac{1}{3}$ of 9.75 miles? In $\frac{1}{3}$ of 6.039 miles?

9.75 mi. ÷ 3 = ?

$$\begin{array}{r} 3.25 \text{ mi.} \\ 3\overline{)9.75 \text{ mi.}} \end{array}$$

$\frac{1}{3}$ of 9.75 mi. = 3.25 mi.

6.039 mi. ÷ 3 = ?

$$\begin{array}{r} 2.013 \text{ mi.} \\ 3\overline{)6.039 \text{ mi.}} \end{array}$$

$\frac{1}{3}$ of 6.039 mi. = 2.013 mi.

3. How many places are pointed off in the quotient in finding $\frac{1}{3}$ of 9.75 miles? In finding $\frac{1}{3}$ of 6.039 miles? Explain why.

In dividing a decimal by an integer, point off in the quotient a number of decimal places equal to the number in the dividend.

[With pencil.]

Divide:

4. $.75 by 3.	10. .96 by 3.	16. 6.25 by 25.
5. $.875 by 7.	11. .625 by 5.	17. 28.8 by 24.
6. $4.52 by 4.	12. 32.8 by 4.	18. 73.92 by 32.
7. $2.576 by 8.	13. 275.5 by 5.	19. 753.3 by 31.
8. $52.50 by 25.	14. 26.4 by 24.	20. 4.704 by 42.
9. $4.494 by 14.	15. 36.96 by 16.	21. 62.464 by 61.

22. In a 3-hour airship race, the winner rode 436.5 miles. What was his average rate of speed per hour?

23. In a 6-day bicycle race, the winner rode 2731.2 miles. Find the average number of miles covered per day.

24. A passenger train travels 962.88 miles in 24 hours. Find the average number of miles per hour.

69. Exercises for Skill

[With pencil.]

Add:

1. .375, .24, .348, .48, .9, .084, .84.
2. 34.24, 38.5, 24.27, 64.87, 8.17, 9.6.
3. .247, 3.845, 9.8, 6.252, 24.875.
4. 84.675, .875, 96.5, 89.9, 984.425.
5. 6.394, 89, 76, 14.24, .327, 8.427.

Subtract:

6. .375 from .625.	7. .84 from 1.12.	8. 4.75 from 6.48.

9. 24.8 from 72.64.
10. 9.3 from 74.85.
11. 8.4 from 24.9.
12. 6.23 from 7.9.
13. 4.24 from 18.8.
14. 6.372 from 8.49.

Multiply:

15. 8.42 by 24.
16. 7.8 by 20.
17. 3.125 by 304.
18. 9.25 by 400.
19. 24.9 by 72.
20. 8.5 by 4.5.
21. .005 by 75.
22. .325 by .2.
23. 28.9 by .08.

Divide:

24. 29.85 by 3.
25. 4.25 by 5.
26. 9.7 by 8.
27. 65.02 by 4.
28. 8.793 by 9.
29. 73.92 by 32.
30. 7.062 by 22.
31. 806.5 by 25.
32. 998.03 by 43.

70. Running a Motor-Boat

[With pencil.]

1. Traveling at the rate of a mile in 3.5 minutes, how long does it take a motor-boat to make a five-mile trip?

2. Around a lake the distances between the stations at which the motor-boat stops are: from the first to the second, 2.25 miles; from the second to the third, 1.75 miles; from the third to the fourth, .625 miles; from the fourth back to the first, 2.375 miles. What is the total distance covered in making the trip around the lake?

3. At the rate of $.035 per mile for gasoline, how much does the gasoline cost for one trip around the lake?

4. Twelve-trip tickets are sold at the rate of $.375 per trip. How much should be charged for one such ticket?

5. Single tickets are sold at 50¢ apiece. How much is saved on a trip by a customer who uses a twelve-trip ticket?

6. On one excursion 6 passengers buy single-fare tickets, and 3 pay their fares from their twelve-trip tickets. What is the value of the fares received?

7. Find the value of the fares for a day when 18 cash fares are collected at 50¢ apiece, and 24 tickets at $.375 apiece.

8. What is the difference in the value of 20 cash fares at 50¢ each and the same number of tickets at $.375 each?

71. Running an Automobile

[With pencil.]

In many cities large automobiles are used to show strangers the sights of interest.

1. A sight-seeing automobile travels 38.2 miles in the morning, 35.2 miles in the afternoon, and 26.6 miles in the evening. What is the entire distance covered during the day?

2. What is the difference in the distance covered in 3 hours, traveling at the rate of 18.2 miles an hour, and that covered in the same time at the rate of 14.5 miles an hour? (Find two ways of solving this problem; then choose the easier way.)

3. At the rate of $1.25 a passenger, how much more is received from a load of 24 passengers than from a load of 18?

4. With an expense of $.035 per mile for gasoline, how much does the gasoline cost for a trip 20 miles long? For one 60 miles long?

*5. How much more than the cost of the gasoline used is received in fares on a 30-mile trip when 20 passengers are carried at $.75 a passenger and the gasoline costs $.045 per mile?

72. Test and Graded Practice

With the help of this test find out and overcome your difficulties with decimals. If you fail to get the right answer to a problem in the test, practice solving the problems in the set below having the same letter, then try the problem again.

Test No. 18 [With pencil.]

A. Write as decimals: $\frac{7}{10}$, $\frac{25}{100}$, $\frac{5}{1000}$, $4\frac{8}{10}$, $12\frac{8}{100}$, $2\frac{12}{1000}$.

B. Add: 8.72, 43.46, .65, 2.8, 24.

C. 7.925 − 3.49 = ?

D. 9.5 − 1.34 = ?

E. 8.74 × 3.5 = ?

F. .38 × .2 = ?

G. 51.24 ÷ 42 = ?

PRACTICE

[Copy problems only when necessary.]

A. Write as decimals:

1. $\frac{1}{10}$, $\frac{7}{10}$, $2\frac{1}{10}$, $13\frac{7}{10}$.
2. $\frac{1}{100}$, $\frac{8}{100}$, $\frac{27}{100}$, $1\frac{14}{100}$.
3. $2\frac{75}{100}$, $3\frac{7}{100}$, $\frac{1}{1000}$, $\frac{8}{1000}$.
4. $\frac{25}{1000}$, $2\frac{8}{1000}$, $4\frac{25}{1000}$, $9\frac{148}{1000}$.

B. Add in columns and then by rows:

	5.	6.	7.	8.	9.
10.	2.148	7.529	1.125	5.75	84.75
11.	3.75	6.43	1.37	14.42	7.106
12.	8.125	15.876	4.96	9.48	88.75
13.	9.16	12.8	5.842	7.9	677.6
14.	14.003	20.42	2.67	14.3	729.74

C. Subtract:

15. .437 from .942.
16. 3.24 from 9.73.
17. .34 from .724.
18. .74 from 11.21.
19. 4.28 from 13.792.
20. .876 from 15.464.

D. Subtract:

21. 1.38 from 4.2.
22. 8.73 from 14.7.
23. .24 from 4.1.
24. .67 from 11.9.
25. 1.24 from 8.
26. .322 from 15.

Multiply:

E.	27. 42.3 × 4	28. .321 × 17	29. 96 × .8	30. 124 × .04	31. 52.3 × 4.2	32. 6.14 × 3.1
F.	33. .03 × 3	34. .017 × 2	35. .23 × .4	36. 1.6 × .03	37. 1.3 × .04	38. .014 × 21

G. Divide:

39. $7\overline{).966}$	41. $42\overline{)142.8}$	43. $34\overline{)7.378}$
40. $8\overline{)1.16}$	42. $25\overline{)52.75}$	44. $214\overline{)729.74}$

73. Review and Problem Test

[Without pencil.]

1. Give the table of United States money. Why is the system used in United States money called a decimal system?

2. How many mills are there in $\frac{1}{2}$ cent? In $\frac{8}{10}$ of a cent?

3. What part of a cent is 4 mills? 8 mills?

4. Read: \$.007, \$.043, \$.256, \$2.745.

5. What is meant by a decimal fraction?

6. Read: 4.8 ft., 485.24 mi., .005 T., 1.125 lb.

[With pencil.]

7. What is the weight of three parcels if the first weighs 3.375 lb.; the second, 8.5 lb.; and the third, 4.25 lb.?

8. Cloth is bought at \$1.125 a yard and sold for \$1.35 a yard. Find the profit on 30 yards.

9. A train traveling at the rate of 45.5 miles per hour makes a run 8.5 hours long. What is the distance covered?

10. The full fare between two cities is \$9.78. Find the cost of 3 half-fare tickets.

11. The distance covered by a steamboat in 4 hours is 75.24 miles. What is the average rate of speed per hour?

CHAPTER VII. BUYING AND SELLING

74. Aliquot Parts of a Dollar: Halves, Fourths, and Eighths

I

[Without pencil.]

1. What is the price per box when 4 boxes of paper sell for $1.00?

2. What is $\frac{1}{4}$ of $1.00? What is $\frac{2}{4}$, or $\frac{1}{2}$, of a dollar? What is $\frac{3}{4}$ of a dollar?

3. What part of a dollar is 50¢? 25¢? 75¢?

4. At $1.00 a yard, what is the cost of $\frac{1}{2}$ yard of cloth? Of $\frac{1}{4}$ of a yard? Of $\frac{3}{4}$ of a yard?

5. When buttons sell 8 cards for $1.00, what is the price per card?

6. Find how many cents there are in $\frac{1}{8}$ of $1.00. In $\frac{2}{8}$, or $\frac{1}{4}$, of $1.00. In $\frac{3}{8}$. In $\frac{4}{8}$, or $\frac{1}{2}$. In $\frac{5}{8}$. In $\frac{6}{8}$, or $\frac{3}{4}$. In $\frac{7}{8}$. In $\frac{8}{8}$.

7. Add:

$12\frac{1}{2}$	25	$37\frac{1}{2}$	50	$62\frac{1}{2}$	75	$87\frac{1}{2}$
$12\frac{1}{2}$	$12\frac{1}{2}$	$12\frac{1}{2}$	$12\frac{1}{2}$	$12\frac{1}{2}$	$12\frac{1}{2}$	$12\frac{1}{2}$

8. Practice counting to 100 by $12\frac{1}{2}$.

9. Copy and complete, then learn:[1]

$\frac{1}{8}$ of $1.00 = —.	$\frac{5}{8}$ of $1.00 = —.	25¢ = — of $1.00.
$\frac{2}{8}$, or $\frac{1}{4}$, of $1.00 = —.	$\frac{6}{8}$, or $\frac{3}{4}$, of $1.00 = —.	50¢ = — of $1.00.
$\frac{3}{8}$ of $1.00 = —.	$\frac{7}{8}$ of $1.00 = —.	75¢ = — of $1.00.
$\frac{4}{8}$, or $\frac{1}{2}$, of $1.00 = —.	$\frac{8}{8}$ of $1.00 = —.	$12\frac{1}{2}$¢ = — of $1.00.

[1] To help in mastering the tables, use the following contest. Write the aliquot parts $12\frac{1}{2}$¢, $37\frac{1}{2}$¢, etc., on the blackboard. Choose two children to race; choose, also, one child to call off the winner, and another to keep score. The score keeper writes

$37\frac{1}{2}$¢ = — of \$1.00. $87\frac{1}{2}$¢ = — of \$1.00.

$62\frac{1}{2}$¢ = — of \$1.00. $112\frac{1}{2}$¢ = — of \$1.00.

II

[Without pencil.]

1. What is the price for each glass dish when 4 sell for \$1.00? When 8 sell for \$1.00?

2. At $12\frac{1}{2}$¢ each, how much must be paid for 3 saucers? For 6 saucers? For 7?

At \$1.00 a yard, find the cost:

3. Of $\frac{1}{4}$ yard of lawn. Of $\frac{1}{2}$ yard. Of $\frac{3}{4}$ of a yard.

4. Of $1\frac{1}{4}$ yards of muslin. Of $2\frac{1}{2}$ yards. Of $1\frac{3}{4}$ yards.

5. Of $\frac{1}{8}$ of a yard of cambric. Of $\frac{3}{8}$ of a yard. Of $\frac{5}{8}$ of a yard.

6. Of $1\frac{1}{8}$ yards of challie. Of $2\frac{7}{8}$ yards.

7. What part of a dollar is paid for a yard of cotton when 75¢ is paid? When $37\frac{1}{2}$¢ is paid? When $87\frac{1}{2}$¢ is paid? When $62\frac{1}{2}$¢ is paid?

75. Aliquot Parts of a Dollar: Halves, Thirds, and Sixths

[Without pencil.]

1. When stockings sell 3 pairs for \$1.00, what is the price per pair?

2. What is $\frac{1}{3}$ of \$1.00? What is $\frac{2}{3}$ of \$1.00?

3. What part of a dollar is $33\frac{1}{3}$¢? What part of a dollar is $66\frac{2}{3}$¢?

4. When 6 handkerchiefs sell for \$1.00, what is the price paid for each?

the initials of the two contestants on the blackboard; the two contestants take pointers; and, as the teacher calls off "$\frac{1}{8}$ of \$1.00," "$\frac{3}{8}$ of \$1.00," etc., each child tries to be the first to touch the equivalent number of cents. The winner's name is called, and the score keeper writes 1 under his initials. The game continues until one child has scored 6 points. Then the winner chooses two other contestants.

The pupils will find an adaptation of the game on page 41 also helpful in giving them mastery of these facts.

5. Find $\frac{1}{8}$ of \$1.00. $\frac{3}{8}$, or $\frac{1}{3}$, of \$1.00. $\frac{5}{8}$, or $\frac{1}{2}$, of \$1.00. $\frac{4}{8}$, or $\frac{2}{3}$, of \$1.00. $\frac{6}{8}$ of \$1.00. $\frac{7}{8}$ of \$1.00.

6. Add:

$16\frac{2}{3}$	$33\frac{1}{3}$	50	$66\frac{2}{3}$	$83\frac{1}{3}$
$16\frac{2}{3}$	$16\frac{2}{3}$	$16\frac{2}{3}$	$16\frac{2}{3}$	$16\frac{2}{3}$

7. Practice counting to 100 by $16\frac{2}{3}$.

8. Complete, then learn:

$\frac{1}{8}$ of \$1.00 = —. $\frac{3}{8}$, or $\frac{1}{2}$, of \$1.00 = —. $\frac{5}{8}$ of \$1.00 = —.

$\frac{2}{3}$, or $\frac{1}{3}$, of \$1.00 = —. $\frac{4}{8}$, or $\frac{2}{3}$, of \$1.00 = —. $\frac{6}{8}$ of \$1.00 = —.

9. A carpenter buys hinges at the rate of \$1.00 a dozen. How much must he pay for $\frac{1}{3}$ of a dozen? For $1\frac{1}{3}$ dozen?

10. At the rate of \$1.00 a dozen, how much must a housekeeper pay for $\frac{2}{3}$ of a dozen fruit jars? For $1\frac{2}{3}$ dozen?

11. At \$1.00 a yard, find the cost of $\frac{1}{8}$ of a yard of silk. Of $\frac{5}{8}$ of a yard of sash ribbon. Of $1\frac{5}{8}$ yards of velveteen.

12. What part of a dollar is charged for an article marked at $16\frac{2}{3}$¢? For one at $83\frac{1}{3}$¢?

13. At $16\frac{2}{3}$¢ apiece how many glass tumblers can be bought for \$1.00? For \$2.00?

14. Paring knives bought at the rate of 6 for a dollar are sold at 25¢ apiece. What is the gain on each?

15. Plates marked 20¢ apiece cost how much more apiece than those selling 6 for a dollar?

16. How much more is paid for each plate when they are bought at the rate of 3 for a dollar than at the rate of 4 for a dollar?

17. Find the difference in the price of each dish when sauce-dishes are bought at the rate of 5 for a dollar and when they are bought at the rate of 6 for a dollar.

76. Division of Fractions

I

[Use pencil for drawings only.]

1. Two pounds of candy are to be put into boxes holding one half pound each. How many boxes are needed?

2. How many lengths one half yard long can be cut from 1 yard of ribbon? From 3 yards?

3. How many times is $\frac{1}{2}$ contained in 1? In 2? In 3?

4. Three apples are each divided into quarters. How many quarters are there?

5. How many quarter-inches are there in 1 inch? In 2 inches?

6. How many times is $\frac{1}{4}$ contained in 1? In 2? In 3?

7. Four sheets of paper are each divided into thirds. How many thirds are there?

8. Show by a drawing how many times $\frac{1}{3}$ of a circle is contained in 2 circles of the same size. In 4 circles.

9. $1 \div \frac{1}{2} = ?$	10. $1 \div \frac{1}{4} = ?$	11. $1 \div \frac{1}{3} = ?$	12. $3 \div \frac{1}{2} = ?$
$2 \div \frac{1}{2} = ?$	$2 \div \frac{1}{4} = ?$	$2 \div \frac{1}{3} = ?$	$4 \div \frac{1}{4} = ?$
$4 \div \frac{1}{2} = ?$	$5 \div \frac{1}{4} = ?$	$4 \div \frac{1}{3} = ?$	$7 \div \frac{1}{3} = ?$

II

[Without pencil.]

(1) How many times are 3 inches contained in 4 inches? How many times are 3 fourths contained in 4 fourths or one whole?

3 inches are contained in 4 inches $1\frac{1}{3}$, or $\frac{4}{3}$, times.
3 fourths are contained in 4 fourths $1\frac{1}{3}$, or $\frac{4}{3}$, times.

(2) How many times are 2 thirds contained in 3 thirds, or one?

(3) How many times are 2 fifths contained in 5 fifths, or one?

(1) $1 \div \frac{3}{4} = \frac{4}{3}$. (2) $1 \div \frac{2}{3} = \frac{3}{2}$. (3) $1 \div \frac{2}{5} = \frac{5}{2}$.

It can be seen from the problems above that, in dividing 1 by a fraction,

the terms of the fraction expressing the quotient are the same numbers as those in the divisor, but they are in a different position. They are *inverted.* (A boy standing on his head is inverted; the reflection of a tree in water shows the tree inverted; and a fraction turned upside down is inverted.) $\frac{3}{4}$ inverted is $\frac{4}{3}$; $\frac{2}{3}$ inverted is $\frac{3}{2}$; $\frac{3}{5}$ inverted is $\frac{5}{3}$; 2 (which equals $\frac{2}{1}$) inverted is $\frac{1}{2}$.

1. Invert the terms: $\frac{4}{5}$, $\frac{7}{8}$, $\frac{9}{7}$, $\frac{5}{12}$, $\frac{3}{11}$, $\frac{7}{2}$, $\frac{5}{6}$.

2. $1 \div \frac{3}{8} = ?$
3. $1 \div \frac{4}{7} = ?$
4. $1 \div \frac{5}{6} = ?$
5. $1 \div \frac{8}{3} = ?$
6. $1 \div \frac{4}{11} = ?$
7. $1 \div \frac{5}{12} = ?$

III

How many times is $\frac{3}{4}$ of a yard contained in 3 yards?

3 yd. $\div \frac{3}{4}$ yd. = ?

Since $1 \div \frac{3}{4} = \frac{4}{3}$, then $3 \div \frac{3}{4} = 3 \times \frac{4}{3}$, or 4.

$\frac{3}{4}$ of a yard is contained in 3 yards, 4 times.

How many times is $\frac{3}{4}$ of a yard contained in $\frac{7}{8}$ of a yard?

$\frac{7}{8}$ yd. $\div \frac{3}{4}$ yd. = ?

$$\frac{7}{8} \div \frac{3}{4} = \frac{7}{\cancel{8}_{2}} \times \frac{\cancel{4}}{3} = \frac{7}{6}, \text{ or } 1\tfrac{1}{6}.$$

$\frac{3}{4}$ of a yard is contained in $\frac{7}{8}$ of a yard $1\frac{1}{6}$ times.

To divide a number by a fraction, invert the terms of the divisor, and proceed as in multiplication.

[Use pencil only when needed.]

1. Divide 8 by $\frac{2}{3}$; 9 by $\frac{3}{5}$; 20 by $\frac{5}{6}$; 14 by $\frac{2}{7}$; $\frac{5}{12}$ by $\frac{5}{6}$.

2. How many Christmas presents can be wrapped with 6 sheets of paper, if each takes $\frac{1}{2}$ sheet?

3. Photographs are to be tied up with silver cord. How many can be tied up with 7 yards of cord, if each photograph takes $\frac{7}{8}$ of a yard?

4. Boxes are to be filled with candy. How many boxes are required to hold 6 pounds, if each box holds $\frac{3}{4}$ of a pound?

Find the value of:

5. $8 \div \frac{2}{5}$. 8. $24 \div \frac{4}{5}$. 11. $35 \div \frac{5}{8}$. 14. $\frac{7}{8} \div \frac{1}{2}$. 17. $\frac{2}{9} \div \frac{2}{3}$.

6. $12 \div \frac{3}{4}$. 9. $18 \div \frac{9}{11}$. 12. $42 \div \frac{6}{7}$. 15. $\frac{7}{12} \div \frac{3}{4}$. 18. $\frac{5}{8} \div \frac{15}{16}$.

7. $16 \div \frac{4}{7}$. 10. $27 \div \frac{3}{4}$. 13. $63 \div \frac{7}{8}$. 16. $\frac{4}{5} \div \frac{8}{5}$. 19. $\frac{1}{2} \div \frac{7}{8}$.

77. Division of Mixed Numbers

(1) How many jelly glasses holding $\frac{1}{2}$ pint each are required for $3\frac{1}{2}$ pints of jelly?

$3\frac{1}{2} \div \frac{1}{2} = ?$

$3\frac{1}{2} = \frac{7}{2}$. $\frac{7}{2} \div \frac{1}{2} = \frac{7}{2} \times 2$, or 7.

(2) How many cakes requiring $1\frac{1}{2}$ cups of sugar can be made from $4\frac{1}{2}$ cups of sugar?

$4\frac{1}{2} \div 1\frac{1}{2} = ?$

$4\frac{1}{2} = \frac{9}{2}$. $1\frac{1}{2} = \frac{3}{2}$. $\frac{9}{2} \div \frac{3}{2} = \frac{9}{2} \times \frac{2}{3}$, or 3.

In the division of fractions, change mixed numbers to improper fractions.

[With pencil.]

1. $4\frac{1}{2} \div \frac{3}{5} = ?$ 6. $5\frac{1}{5} \div \frac{8}{15} = ?$ 11. $3\frac{1}{3} \div 1\frac{1}{2} = ?$

2. $7\frac{1}{2} \div \frac{3}{7} = ?$ 7. $7\frac{1}{3} \div \frac{11}{15} = ?$ 12. $6\frac{7}{8} \div 4\frac{1}{2} = ?$

3. $16\frac{1}{2} \div \frac{11}{12} = ?$ 8. $6\frac{3}{4} \div \frac{9}{16} = ?$ 13. $1\frac{7}{8} \div 2\frac{1}{2} = ?$

4. $8\frac{1}{4} \div \frac{11}{16} = ?$ 9. $8\frac{2}{3} \div \frac{2}{9} = ?$ 14. $37\frac{1}{2} \div 6\frac{1}{4} = ?$

5. $11\frac{3}{8} \div \frac{7}{9} = ?$ 10. $5\frac{1}{4} \div 2\frac{1}{3} = ?$ 15. $22\frac{1}{2} \div 6\frac{3}{7} = ?$

16. How many strips of cloth $1\frac{1}{2}$ yards long can be cut from a strip 12 yards long?

17. How many times is $1\frac{1}{3}$ yd. contained in $9\frac{1}{3}$ yd?

78. Division of Fractions by Integers

What is the length of each piece of ribbon when $\frac{3}{4}$ of a yard is cut into 2 equal lengths? When $3\frac{1}{2}$ yards is cut into 3 equal lengths?

(1) $\frac{3}{4} \div 2 = ?$

$\frac{3}{4} \div 2 = \frac{3}{4} \times \frac{1}{2}$, or $\frac{3}{8}$.

Length of each piece, $\frac{3}{8}$ of a yard.

(2) $3\frac{1}{2} \div 3 = ?$

$3\frac{1}{2} = \frac{7}{2}$. $\frac{7}{2} \div 3 = \frac{7}{2} \times \frac{1}{3}$, or $\frac{7}{6}$. $\frac{7}{6} = 1\frac{1}{6}$.

Length of each piece, $1\frac{1}{6}$ yards.

Notice that dividing a number by 2 is the same as multiplying by $\frac{1}{2}$, and that dividing by 3 is the same as multiplying by $\frac{1}{3}$.

1. Divide $\frac{1}{3}$ by 2; $\frac{1}{2}$ by 4; $\frac{7}{8}$ by 2; $\frac{3}{4}$ by 3; $\frac{2}{3}$ by 4; $\frac{5}{6}$ by 2.

2. Divide $4\frac{1}{2}$ by 3; $2\frac{1}{2}$ by 2; $3\frac{1}{3}$ by 5; $5\frac{3}{4}$ by 3; $4\frac{1}{4}$ by 2.

3. A line $7\frac{1}{2}$ inches long is divided into 3 equal lengths. How long is each section?

4. Find the length of each section when a line $3\frac{1}{2}$ inches long is divided into 2 sections. When a line $2\frac{3}{4}$ inches long is divided into 3 sections.

79. Test and Graded Practice

This test is to help you find out and overcome your difficulties in the division of fractions. If you fail to get the right answer to a problem in the test, practice solving the problems in the set below having the same letter, then try the problem again.

Test No. 19. [Copy problems only when necessary.]

A. $12 \div \frac{3}{4} = ?$ C. $7\frac{1}{2} \div \frac{3}{5} = ?$ E. $12 \div 2\frac{2}{3} = ?$

B. $\frac{5}{16} \div \frac{5}{8} = ?$ D. $6\frac{2}{3} \div 4 = ?$ F. $4\frac{3}{4} \div 1\frac{1}{2} = ?$

PRACTICE

A.	B.	C.
1. $3 \div \frac{1}{2} = ?$	6. $\frac{3}{4} \div \frac{1}{3} = ?$	11. $5\frac{1}{3} \div \frac{2}{3} = ?$
2. $8 \div \frac{2}{3} = ?$	7. $\frac{3}{8} \div \frac{3}{16} = ?$	12. $4\frac{4}{5} \div \frac{3}{5} = ?$
3. $15 \div \frac{5}{6} = ?$	8. $\frac{5}{12} \div \frac{5}{6} = ?$	13. $2\frac{3}{4} \div \frac{1}{2} = ?$
4. $7 \div \frac{2}{3} = ?$	9. $\frac{5}{9} \div \frac{2}{3} = ?$	14. $3\frac{1}{2} \div \frac{3}{8} = ?$
5. $12 \div \frac{8}{11} = ?$	10. $1\frac{1}{2} \div \frac{3}{4} = ?$	15. $1\frac{4}{5} \div \frac{5}{6} = ?$

D.	E.	F.
16. $\frac{4}{5} \div 2 = ?$	22. $12 \div 1\frac{1}{3} = ?$	28. $\frac{5}{6} \div 1\frac{1}{4} = ?$
17. $\frac{2}{3} \div 3 = ?$	23. $10 \div 2\frac{1}{2} = ?$	29. $\frac{3}{4} \div 2\frac{3}{5} = ?$
18. $\frac{1}{2} \div 16 = ?$	24. $8 \div 2\frac{1}{3} = ?$	30. $\frac{7}{8} \div 2\frac{2}{3} = ?$
19. $5\frac{1}{2} \div 6 = ?$	25. $9 \div 1\frac{1}{4} = ?$	31. $4\frac{2}{3} \div 1\frac{3}{5} = ?$
20. $3\frac{3}{4} \div 3 = ?$	26. $12 \div 3\frac{1}{3} = ?$	32. $3\frac{3}{4} \div 2\frac{3}{5} = ?$
21. $5\frac{1}{3} \div 12 = ?$	27. $24 \div 2\frac{2}{7} = ?$	33. $5\frac{1}{2} \div 2\frac{1}{4} = ?$

80. Comparison

I

[Without pencil.]

1. A 6-inch line is what part of a 12-inch line? A 10-inch line is what part of a 30-inch line? A 12-inch line is what part of a 48-inch line?

2. A package weighing 6 oz. is how many times as heavy as one weighing 3 oz.? A package weighing 16 oz. is how many times as heavy as one weighing 5 oz.?

A comparison between two numbers answers one of two questions: What part? or, How many times?

(1) What part of 24 oranges are 18 oranges?

Since 1 orange is $\frac{1}{24}$ of 24 oranges, 18 oranges are $\frac{18}{24}$ of 24 oranges. $\frac{18}{24} = \frac{3}{4}$.

(2) How many times 18 oranges are 24 oranges?

24 oranges are $\frac{24}{18}$, or $1\frac{1}{3}$, times 18 oranges.

To compare two numbers, express the comparison by writing the numbers as a fraction, and then reduce the fraction to its simplest form.

3. $10 is what part of $15?

4. 18 days are what part of 24 days?

5. 30 miles are what part of 50 miles?

6. A yard is how many times as long as a 24-inch line?

7. A pound is how many times as heavy as 14 ounces?

8. Compare 8 lemons with 12 lemons; 9 oranges with 15 oranges; 16 apples with 24 apples.

9. Compare 12 pears with 9 pears; 18 peaches with 12 peaches.

10. Compare 12 years with 10 years; 63 days with 27 days.

11. Compare 50¢ with 75¢; 40¢ with 50¢; 35¢ with 42¢.

Compare:

12. 40 with 80.	17. 77 with 55.	22. 99 with 33.
13. 25 with 75.	18. 28 with 35.	23. 40 with 48.
14. 24 with 30.	19. 16 with 20.	24. 54 with 63.
15. 16 with 32.	20. 25 with 20.	25. 60 with 40.
16. 24 with 36.	21. 64 with 96.	26. 48 with 96.

II

(1) At the rate of 20¢ a dozen, what is the cost of 9 pears?

9 pears are $\frac{3}{4}$ of 12 pears and cost $\frac{3}{4}$ of 20¢, or 15¢.

(2 At the rate of 6 for 25¢, what is the cost of 9 bananas?

9 bananas are $1\frac{1}{2}$ times 6 bananas and cost $1\frac{1}{2}$ times 25¢, or $37\frac{1}{2}$¢.

[Without pencil.]

1. If you were to buy 12 oranges at the rate of 3 for 20¢, how much would you have to pay?

2. At the rate of 60¢ a dozen, how much must be paid for 4 lemons? For 2 lemons? For 8 lemons?

3. A large crate holds 32 quart boxes of berries. At the rate of $8.00 a crate, how much is paid for 8 quarts of blackberries? For 16 quarts? For 24 quarts?

4. Use this price list for problems:

Bananas, 3 for 10¢.	Oranges, 6 for 25¢.
Apples, 6 for 10¢.	Pears, 6 for 15¢.

81. Review and Progress Score

Use Exercise I for practice, then try to make a record of 100 points on Exercise II, counting 10 for each correct answer.

I. Review

[Use pencil only when needed.]

Add, subtract, multiply, and divide with each pair of fractions:

1. $\frac{2}{3}, \frac{1}{3}$.
2. $\frac{3}{5}, \frac{1}{5}$.
3. $\frac{6}{7}, \frac{2}{7}$.
4. $\frac{7}{8}, \frac{3}{8}$.
5. $\frac{7}{9}, \frac{5}{9}$.
6. $\frac{11}{12}, \frac{5}{12}$.
7. $\frac{2}{3}, \frac{1}{2}$.
8. $\frac{7}{8}, \frac{3}{4}$.
9. $\frac{4}{5}, \frac{2}{3}$.
10. $\frac{11}{12}, \frac{5}{6}$.
11. $\frac{5}{7}, \frac{1}{2}$.
12. $\frac{11}{12}, \frac{3}{8}$.
13. $\frac{3}{4}, \frac{3}{5}$.
14. $\frac{6}{7}, \frac{3}{8}$.
15. $\frac{5}{6}, \frac{5}{8}$.

Find and test answers:

16. $20\frac{2}{3} + 10\frac{1}{4} + 8\frac{1}{2} = ?$
17. $6\frac{1}{2} + 2\frac{1}{5} + 3\frac{7}{10} = ?$
18. $2\frac{4}{5} + 15\frac{3}{4} + 7\frac{9}{10} = ?$
19. $.142 + .274 + .39 = ?$
20. $2.48 + 3.4 + 9.008 = ?$
21. $\$4.85 + .075 + \$8.792 = ?$

22. $24\frac{3}{4} - 12\frac{1}{2} = ?$
23. $40 - 25\frac{2}{3} = ?$
24. $39\frac{1}{2} - 27\frac{7}{8} = ?$
25. $\frac{5}{16} \times \frac{5}{15} = ?$
26. $48 \times \frac{2}{3} = ?$
27. $40 \times 2\frac{1}{5} = ?$
28. $30 \times 3\frac{1}{3} = ?$
29. $15\frac{1}{2} \times 6 = ?$
30. $7\frac{2}{5} \times 2\frac{1}{2} = ?$
31. $8\frac{1}{3} \times 2\frac{1}{2} = ?$
32. $18 \div \frac{1}{4} = ?$
33. $\frac{5}{12} \div \frac{2}{3} = ?$
34. $12\frac{1}{2} \div \frac{1}{2} = ?$
35. $16\frac{2}{3} \div \frac{1}{4} = ?$
36. $4\frac{2}{3} \div 1\frac{3}{4} = ?$

37. $4.842 - 1.348 = ?$
38. $2.75 - 1.128 = ?$
39. $\$70.25 - \$34.375 = ?$
40. $14.28 \times 3.2 = ?$
41. $.09 \times .3 = ?$
42. $8.775 \div 3 = ?$
43. $17.28 \div 24 = ?$
44. $3.456 \div 36$?

II. Progress Score

[With pencil.]

1. $24\frac{4}{5} + 12\frac{3}{4} = ?$
2. $2.14 + 3.442 + 4.8 = ?$
3. $24\frac{5}{12} - 3\frac{1}{8} = ?$
4. $18.42 - 4.124 = ?$
5. $\frac{11}{12} \times \frac{3}{5} = ?$
6. $4\frac{1}{2} \times 12 = ?$
7. $3\frac{1}{2} \times 2\frac{1}{4} = ?$
8. $4.28 \times 3.7 = ?$
9. $9\frac{3}{8} + \frac{5}{12} = ?$
10. $6.72 \div 21 = ?$

82. Selling Goods

I. Clerking in a Dry-Goods Shop

[Without pencil.]

Find how much should be charged each of the following customers:

1. Mrs. Brown buys $3\frac{1}{2}$ yards of 12-cent cotton cloth.

2. Mr. Clark buys 6 collars at 3 for 50¢.

3. Robert buys 1 dozen handkerchiefs at 3 handkerchiefs for $1.00.

4. Margaret buys $1\frac{1}{4}$ yards of muslin at 40¢ a yard.

5. Elizabeth buys $8\frac{1}{2}$ yards of ribbon at 12¢ a yard and $2\frac{1}{2}$ yards of lace at 10¢ a yard.

6. Richard buys 4 pairs of shoestrings at 2 pairs for 15¢ and 1 pair of bicycle stockings for three quarters of a dollar.

7. Ruth buys $2\frac{1}{2}$ dozen buttons at 20¢ a dozen and $\frac{1}{2}$ yard of cambric at 30¢ a yard.

8. Louise buys $\frac{1}{2}$ dozen spools of thread at 5¢ a spool and 4 balls of darning cotton at 2 balls for 5¢.

9. Two and one half yards of cloth are purchased at 10¢ a yard. How much change should be given from a fifty-cent piece?

10. How much change should be given from a dollar bill when 6 papers of pins are bought at 3 papers for 25 cents?

11. Find the amount of change that should be given from a two-dollar bill when 9 kitchen towels are bought at 6 for $1.00.

12. Material for 2 shirt waists is to be cut from a piece of goods. Each waist requires $2\frac{1}{8}$ yards. How long a piece should be cut?

13. How many yards of cotton cloth should be sold for 3 pillow covers if $1\frac{1}{2}$ yards is to be used for each?

14. The skirt for a little girl's dress requires $2\frac{3}{8}$ yards of gingham; the waist, $1\frac{5}{8}$ yards. How many yards should be sold for the dress?

15. A piece of ribbon $4\frac{3}{8}$ yards long is cut from a bolt containing 40 yards. How many yards are left?

16. Handkerchiefs are selling for $12\frac{1}{2}$¢ apiece. How many should be sold for 50¢? For 75¢?

17. Linen doilies are selling at $1.00 for a half-dozen. How much should be charged for 1 doilie? For 3 doilies?

18. At $1.00 a yard, how much should be charged for $1\frac{3}{8}$ yd. of silk?

[With pencil.]

19. How many yards of material should be sold for two tablecloths if one requires $2\frac{7}{8}$ yards and the other $2\frac{3}{8}$ yards?

20. Two lengths of silk are cut from a bolt containing 32 yards. One piece is $4\frac{3}{4}$ yards long, and the other $6\frac{7}{8}$ yards long. How many yards of the bolt are left?

21. Find the amount left from $48\frac{3}{4}$ yards of linen after 2 pieces, each $8\frac{5}{8}$ yards long, have been cut from it.

22. A customer buys 6 collars at 25¢ each, 4 pairs of stockings at $33\frac{1}{3}$¢ a pair, and 9 handkerchiefs at 6 for $1.00. What is the amount of his bill?

*23. Find the amount of change that should be given from a five-dollar bill in selling $3\frac{3}{4}$ yards of ribbon at 20¢ a yard, $2\frac{1}{2}$ yards of lace at 12¢ a yard, $1\frac{7}{8}$ yards of muslin at 24¢ a yard, and 1 dozen handkerchiefs at $12\frac{1}{2}$¢ apiece.

II. Clerking in a Grocery

With the help of this price list, make and solve ten or more problems on selling groceries:

Sugar, a pound, 11¢, $11\frac{1}{2}$¢.	Cheese, a pound, 24¢, 30¢.
Tea, " " 60¢, 75¢, 90¢.	Eggs, a dozen, 60¢, 70¢, 80¢.
Coffee, " " 50¢, 70¢.	Soap, 2 bars for 25¢.
Flour, " " $7\frac{1}{2}$¢, 8¢.	Fruit jars, 2 for 25¢.
Butter, " " 60¢, 65¢.	Jelly glasses, 12 for $1.00.

83. Problem Test[1]

[Without pencil.]

1. John earns $24 and saves $18. What part of his money does he save?

2. Oranges are selling at 40¢ a dozen. How much must be paid for 9 oranges?

3. Butter is selling at 60¢ a pound. Find the cost of $1\frac{1}{4}$ pounds.

4. At the rate of $16\frac{2}{3}$¢ apiece, how many fruit jars can be bought for $2.00?

5. At $1.00 a yard, what is the price of $\frac{3}{8}$ of a yard of cloth?

6. Dorothy wishes to buy half a pound of chocolate candy. How much more must she pay for the kind that sells for 90¢ a pound than for the kind that sells for 60¢ a pound?

[With pencil.]

7. For lemonade at a picnic, Fred buys $1\frac{1}{2}$ doz. lemons at 40¢ a dozen and 6 lb. of sugar at 12¢ a pound. How much must he pay?

8. Henry had a dollar to spend. He bought 6 pencils at 2 for 5¢, a pencil box for 25¢, and a set of drawing tools for 40¢. Find how much money he had left.

9. From $20\frac{1}{2}$ yards of linen, 2 pieces are cut, each containing $4\frac{7}{8}$ yards. How many yards are left in the piece?

10. From 40 yards of gingham, 3 pieces are cut. The first contains $8\frac{3}{4}$ yards; the second, $6\frac{2}{3}$ yards; and the third, $7\frac{1}{2}$ yards. Find the number of yards left.

11. How many more yards of cambric selling at $12\frac{1}{2}$¢ a yard can be bought for $1.00 than of a better quality selling at 25¢ a yard?

12. Ribbon is bought at $.095 a yard and sold at $.15 a yard. How much is gained on 200 yards?

13. A merchant gains 7¢ on each dozen buttons. How many dozen must he sell to make $35?

[1] See footnote, page 25.

CHAPTER VIII. MEASUREMENTS AND REVIEW

84. Linear Measure

[Use pencil only when needed.]

1. Name the measure commonly used in finding the length of cloth. In finding its width.

2. What measure is used for the depth of a building lot from front to back? For the width of a field? For the distances between cities?

3. Draw three lines. Make the first 1 inch long, the second 1 foot long, and the third 1 yard long.

4. Pace, and then measure, a distance 1 rod long.

5. Name a place 1 mile from your schoolhouse.

6. Try to write from memory the table of linear measure; then compare your table with the one at the end of the book.

Reduce to inches:	Reduce to feet:	Reduce to yards:
7. $1\frac{1}{2}$ ft.	12. $4\frac{1}{3}$ yd.	17. 20 ft.
8. $1\frac{3}{4}$ ft.	13. 1 rd.	18. 100 ft.
9. 2 ft. 7 in.	14. 2 rd.	19. 144 in.
10. $1\frac{1}{4}$ yd.	15. 78 in.	20. $\frac{1}{2}$ rd.
11. 1 yd. 8 in.	16. 100 in.	21. 1 mi.

22. The distance between two telephone poles is $2\frac{1}{2}$ rods. How many feet of wire are required for a single wire between them?

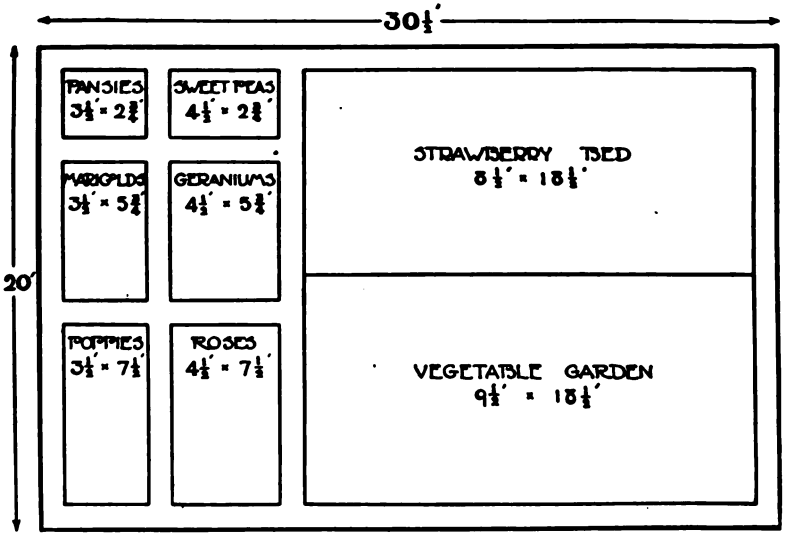
23. A garden is 30 feet wide and 60 feet deep. What are its dimensions in yards?

24. A sidewalk is $18\frac{1}{3}$ yards long. Find its length in feet.

***25. A field is 20 rods wide and 40 rods long. What is its perimeter in feet?**

***26. Find the perimeter in feet of a field $\frac{1}{8}$ of a mile wide and $\frac{1}{4}$ of a mile long.**

85. A Vegetable and Flower Garden



The sign ′ is used for feet.

[Use pencil only when needed.]

1. This is a plan for a home garden in which part of the land is used for vegetables and strawberries and part for flowers. Name the length and width of the entire garden. Of the vegetable garden. Of the strawberry bed.

2. Name the length and width of each flower bed.

3. How many feet of fencing are required to enclose the garden?

4. Find how many feet of string are required to enclose each of the flower beds, if an allowance of $1\frac{1}{2}$ feet is made on each bed for tying the string to the corner pegs.

5. Plants are to be set out in rows running lengthwise of the strawberry bed. Each row is to have an allowance of 2 feet of the width of the bed. The bed is $8\frac{1}{2}$ feet wide. How many rows can be set out?

6. Each row is $18\frac{1}{2}$ feet long. With an allowance of $1\frac{1}{2}$ feet for each plant, how many plants can be set out in each row in the strawberry bed?

7. Find the total number of strawberry plants required.

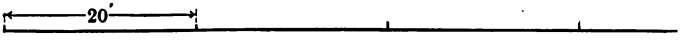
86. Drawing Plans

In order to have the dimensions in the right proportion, plans are drawn to a scale; that is, each distance in the plan stands for a given distance in the object represented by the drawing.

I

[Use pencil for drawings only.]

1. The following line represents the length of a walk. Each inch in the line stands for a distance of 20 feet in the walk. What is the length of the walk?



2. How long a line is required to represent a distance of 40 feet, if each inch in the line stands for a distance of 10 feet?

Name, and then draw, the length of line required to represent:

3. A distance of 25 feet drawn to a scale of 5 feet to an inch.

4. A distance of 42 feet drawn to a scale of 6 feet to an inch.

5. A distance of 100 feet drawn to a scale of 12 feet to an inch.

6. A distance of 14 feet drawn to a scale of 1 foot to $\frac{1}{2}$ inch.

7. A distance of 24 feet drawn to a scale of 1 foot to $\frac{1}{4}$ inch.

*8. Draw the length of line required to represent a distance of 40 feet drawn to a scale of 1 foot to $\frac{3}{16}$ of an inch.

II

[Use pencil for drawings only.]

1. A plan is to be drawn of a rectangular schoolroom 24 feet wide and 30 feet long. How wide should the plan be drawn if the scale used is 6 feet to an inch? How long should the plan be?

2. What are the dimensions of the rectangle required to represent a room 15 feet wide and 20 feet long, drawn to a scale of 5 feet to an inch?

3. A school playground is a rectangle 120 feet wide and 200 feet long. Draw a plan of it to a scale of 40 feet to an inch.

4. Draw the floor plan of a playhouse containing one room 10 feet by 12 feet. Use the scale of 1 foot to $\frac{1}{8}$ of an inch.

5. Draw, to a scale of 1 foot to $\frac{3}{8}$ of an inch, a rectangle to represent a flower garden 8 feet wide and 16 feet long.

*6. A garden 9 feet wide and 11 feet long is divided into 4 beds of equal size with paths 1 foot wide separating them. Make a rough sketch of the garden and then draw a careful plan of it to a scale of 1 foot to $\frac{1}{2}$ of an inch.

87. Square Measure

[Use pencil only when needed.]

In measuring surfaces, square units are often used. In measuring the surface of a sheet of paper, it is convenient to use the square inch. In measuring the floor space in a room or the area of a building lot, the square foot and the square yard are used.

1. Name a surface commonly measured by the acre. By the square mile.

2. Draw on your blackboard a square inch, a square foot, and a square yard. Learn all that you can about them.

3. A square rod may be thought of as a square $16\frac{1}{2}$ feet on a side. With crayon, draw a square rod on your schoolroom floor.

4. How many square inches are there in a square foot? (Show by drawing.)

5. How many square feet equal a square yard? (Mark in drawing.)

6. Learn this table if you do not already know it:

SQUARE MEASURE

144 square inches (sq. in.)	= 1 square foot (sq. ft.)
9 square feet	= 1 square yard (sq. yd.)
$30\frac{1}{4}$ square yards	= 1 square rod (sq. rd.)
160 square rods	= 1 acre (A.)
640 acres	= 1 square mile (sq. mi.)

Reduce:

7. $\frac{1}{4}$ sq. ft. to square inches.
8. $1\frac{1}{2}$ sq. ft. " " "
9. 4 sq. yd. " " feet.
10. $1\frac{1}{3}$ sq. yd. " " "
11. $3\frac{3}{4}$ sq. yd. " " "
12. 1728 sq. in. to square feet.
13. 100 sq. ft. to square yards.
14. 2 sq. rd. " " "
15. $1\frac{1}{2}$ sq. rd. " " "
16. $1\frac{1}{2}$ acres " " rods.

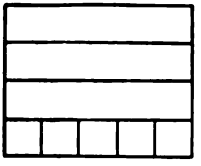
17. A porch floor contains 10 square yards. How many square feet does it contain?

18. Matting is to be laid on a bedroom floor covering 180 sq. ft. An allowance of 1 square yard of matting is to be made for turning in the ends of the strips. Find the number of square yards required, if it is laid without waste.

*19. A hardwood floor costs 35¢ a square foot; linoleum, $1.40 a square yard. Find how much expense is saved by laying the linoleum, instead of a hardwood floor, in a kitchen requiring 15 square yards.

88. Finding Areas

[Use pencil only when needed.]



1. Suppose that this drawing represents a sheet of paper 5 inches long and 4 inches wide. How many square inches are there in each lengthwise row? How many lengthwise rows of square inches does it contain? What is its area in square inches?

To find the area of a rectangle, multiply the number of square units contained in each row of its surface by the number of rows.

2. Draw a rectangle 3 inches wide and 4 inches long. Divide it into square inches and explain how its area is found.

3. Explain, with the help of a drawing, how to find the area of a rectangle 2 inches wide and 5 inches long. Of a rectangle 4 inches wide and 6 inches long.

4. What is the area of a rectangular piece of land 6 feet wide and 8 feet long?

5. Find the area of a flower bed 4 feet wide and 6 feet long. Of one 2 feet wide and 10 feet long. Of one 3 feet wide and 9 feet long.

Find the area of:

6. A kitchen 12 ft. by 12 ft.
7. A library 14 ft. by 16 ft.
8. A bedroom 12 ft. by 14 ft.
9. A house lot 40 ft. by 100 ft.
10. A lawn 30 ft. by 50 ft.
11. A garden 40 ft. by 120 ft.

12. The garden pictured on page 122 is 20 ft. wide and 30½ ft. long. How many square feet does it contain? How many square yards?

13. With the help of the measurements given in the plan, find the area of the strawberry bed. Find the area of the vegetable garden.

14. Find the area of each flower bed (page 122).

15. Find the cost of a piece of linoleum 12 feet by 6 feet at $1.10 a square yard.

16. Find how much more it will cost to cover a floor 15 ft. by 12 ft. with linoleum at $1.75 a yard than at $1.25 a yard.

89. Review of Measures [1]

I

[Use pencil only when needed.]

1. What are the measures that are commonly used for apples, potatoes, wheat, and other fruits, vegetables, and grains?

2. How many times must a peck measure be filled to measure out a bushel of potatoes?

3. How many times must a quart measure be filled to measure a peck of hickory nuts? To measure 1 bushel?

4. Write the table of dry measure.

Reduce:

5. 2 bu. to pecks.
6. ½ bu. " "
7. 4¼ bu. " "
8. 3 pk. to quarts.
9. 1½ pk. " "
10. 24 qt. " pecks.
11. 18 bk. to bushels.
12. 64 qt. " "

Find the cost:

13. Of 1 quart of cherries at 80¢ a peck.
14. Of 1½ pecks of nuts at 5¢ a quart.
15. Of 1 bushel of apples at 40¢ a peck.
16. Of 1½ bushels of pears at 40¢ a peck.
17. Of 1 peck of potatoes at $1.60 a bushel.
18. Of 1 peck of apples at $5.00 a barrel (2½ bu.).

[1] These exercises are a review of work done in previous years. If a class is unfamiliar with the measures, the pupils should be given an opportunity to do actual measuring.

II

[Use pencil only when needed.]

1. By what unit of measure are eggs usually sold?

2. Name fruits that are sold by this same unit of measure.

3. In selling screws and other small articles what name is given to 12 dozen?

12 articles = 1 dozen (doz.)
144 articles, or 12 dozen, = 1 gross

4. How many gross in 24 dozen screws? In 48 dozen screw hooks?

5. I buy $1\frac{1}{2}$ gross of brass fasteners. How many do I buy?

Find the cost:

6. Of $\frac{1}{2}$ dozen glass jars at $6\frac{1}{4}$¢ each.

7. Of 1 gross of hinges at $1.00 a dozen.

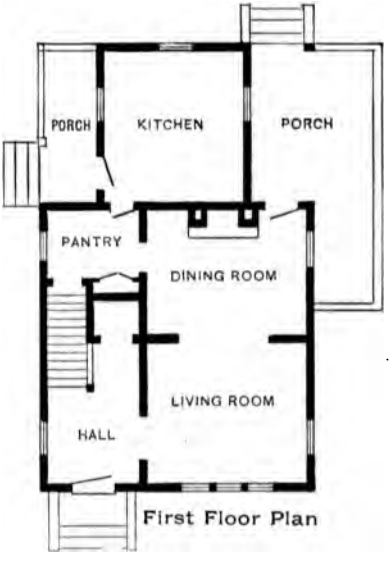
90. Home Improvements[1]

In the home pictured here, new hardwood floors are to be laid in the three main rooms on the first floor; the woodwork in the kitchen and the bedrooms is to be painted; and the walls in the living room and the dining room are to be papered.

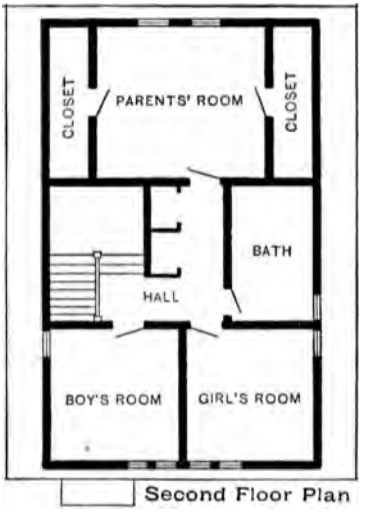
[With pencil.]

1. The kitchen is 12 feet wide and 13 feet long. At 20¢ a square foot, how much will the hardwood floor for the kitchen cost?

[1] The drawings are after illustrations reproduced by courtesy of *The Craftsman.*



First Floor Plan



Second Floor Plan

2. The living room is 14 ft. by 12½ ft.; the dining room, 14 ft. by 11 ft. Find the cost, at 25¢ a square foot, of the hardwood floor in the living room. In the dining room.

3. Find the total cost of the three hardwood floors.

4. For painting the woodwork in the kitchen and in the bedrooms, a painter charges for 2 gallons of paint at $5.50 a gallon, and for 24½ hours of work at 80¢ an hour. How much does the painter charge?

5. The walls in the living room require 12 rolls of paper; those in the dining room, 9 rolls. Find the cost of the paper at 25¢ a roll.

6. The paper hanger requires 1½ days to paper the two rooms. At $5.50 a day, how much does the paper hanger charge for his work?

7. How much does it cost to have the two rooms papered?

*8. Find the total cost of the improvements in problems 1 to 7.

91. Furnishing a House

I. The Kitchen and the Laundry

[With pencil.]

The kitchen and the laundry in the house pictured on page 128 are to be furnished.

1. For the kitchen, a gas range is to be bought for $34.25, a fireless cooker for $24.75, a kitchen cabinet for $40, 2 tables at $4.75 each, and 3 chairs at $1.50 each. How much will these furnishings cost?

2. Curtains the length of the lower sash are to be hung in the kitchen windows. Each curtain requires $1\frac{1}{4}$ yards of muslin. How many yards are required in all for the curtains, if 1 pair is hung at each of the three windows?

3. The muslin for the curtains costs 50¢ a yard. How much must be paid for it?

4. The tables are to be covered with oilcloth. One table requires $1\frac{3}{4}$ yards; the other, $1\frac{2}{3}$ yards. Find the cost of the oilcloth at 60¢ a yard.

5. For cooking utensils, the following are bought. Find the cost of those in each column and then the total cost:

1 teakettle	$1.45	2 mixing bowls	$.70	Muffin tins	$.80
3 small saucepans	.75[1]	6 bread tins	1.80	4 pie plates	.80
1 large saucepan	.60	2 cake tins	.70	1 meat chopper	2.75
1 iron skillet	.75	3 baking dishes	1.50	Knives, forks, etc.	5.00
1 double boiler	1.50	1 roasting pan	1.20	Miscellanies	2.85
1 granite kettle	1.20	6 custard cups	.90	1 freezer	3.50

6. For laundry work, cleaning, and dish washing, the following articles are bought. Find their cost:

1 clothesline	$.60	1 set of flatirons	$2.50	1 dish pan	$.89
1 clothes basket	2.25	2 brooms	1.30	1 dish drainer	.45
3 doz. clothespins	.12	2 scrubbing brushes	.50	1 soap shaker	.15
1 washboard	.64	1 scrubbing pail	.95	2 dish mops	.30
1 wringer	7.65	1 mop	.85	6 dish towels	1.50
1 ironing board	1.75	1 dustpan	.25	1 towel rack	.70

*7. Find the total cost of the furnishings for the kitchen and the laundry.

*8. With the help of advertisements from newspapers, make a price list of articles for the kitchen and laundry. Write the price list on a blackboard for your classmates. Make and solve problems from the list.

II. The Living and Dining Rooms

[With pencil.]

1. For the living room, 3 easy chairs are bought for $9.25 apiece, 2 straight-back chairs for $5.75 apiece, 1 stand for $7.25, 1 bookcase for $12.50, and a Victrola for $35.00. Find the cost of the furniture for the living room.

2. For the dining room, a dining table is bought for $24.75, a serving table for $7.75, and 6 chairs for $4.75 apiece. Find the cost of this furniture.

[1] When items are given in this form, the amount given covers the total cost.

3. A rug is bought for the living room for $44.50, and one for the dining room for $25.75. Five pairs of curtains are bought for the living room at $5.75 a pair, and 2 pairs for the dining room at $3.50 a pair. Find the cost of the rugs and curtains for the two rooms.

4. Four pictures are framed. It costs $4.75 to frame the first, $3.50 to frame the second, $1.80 to frame the third, and $1.65 to frame the fourth. How much is charged for framing them all?

5. For china, the following articles are bought. Find the cost:

1 doz. dinner plates @ 35¢ apiece.

1½ doz. breakfast plates @ 25¢ apiece.

1 doz. desert plates @ 20¢ apiece.

1 doz. bread-and-butter plates @ 15¢ apiece.

1 sugar bowl, 1 teapot, and 1 pitcher for $3.50.

½ doz. cups and saucers @ $3.00 a dozen.

½ doz. cups and saucers @ $2.50 a dozen.

4 vegetable dishes @ $.75 apiece.

3 platters @ 85¢ apiece.

1 salad bowl @ $1.25 and 1 fruit dish @ $.95.

6. Sixteen dollars and fifty cents is spent on table napkins at $5.50 a dozen. How many napkins are bought?

7. Two tablecloths are bought. For one, 2¾ yards of damask are bought at $4.40 a yard; for the other, 2½ yards at $4.00 a yard. How much is paid for the two tablecloths?

*8. The silver, glassware, and other table furnishings not mentioned in problems 5, 6, and 7 amount to $47.50. What is the total cost of the furnishings for the table?

*9. Find the total cost of the furnishings for these two rooms.

*10. Make and solve 3 problems of your own on buying furniture for a living or a dining room.

III. A Girl's Room

[With pencil.]

1. For the girl's room pictured here, a bed and mattress are bought for $35.75, a dressing table for $19.98, a stand for $5.49, a rocking chair for $5.50, and 2 other chairs for $3.75 apiece. Find the cost of the furniture.

2. The girl to whom the room belongs is saving money with which to buy a writing-desk that costs $17.50. At the rate of $1.25 a month, how long will it take her to save the amount needed?

3. The floor of the room is to be covered with matting. How much will it cost at 60¢ a yard, if the amount required is 4 strips each $3\frac{3}{4}$ yards long?

4. For curtains, $16\frac{1}{2}$ yards of muslin are bought. How many curtains, each containing $2\frac{3}{4}$ yards, can be cut from the muslin?

5. The muslin is bought for 40¢ a yard. How much does it cost?

6. A window seat and 3 pillows are to be covered with flowered cretonne. The window seat requires $8\frac{3}{4}$ yards of goods, and the pillows $1\frac{1}{2}$ yards each. How many yards of cretonne should be bought?

7. Find the cost of the cretonne at 40¢ a yard.

*8. Find the total cost of the furnishings of this room, including all the items mentioned above, with the exception of the writing-desk.

IV. A Boy's Room

[Use pencil only when needed.]

1. For the boy's room pictured in the plan on page 129, a bookcase and three picture frames are to be made. The bookcase requires 6 shelves each 3 feet long and 2 end boards each $4\frac{1}{4}$ feet long.

If the parts of the bookcase are cut from boards of the required width, how many boards 9 feet long are required for the shelves? For the entire bookcase?

2. The lumber for the bookcase costs $6.25; the stain and finish, 60¢; the screws, 15¢. What was the total cost of the material in the bookcase?

3. The outside measurements for the three picture frames are as follows: for No. 1, 24 in. by 18 in.; for No. 2, 20 in. by 14½ in.; for No. 3, 24½ in. by 12¾ in. Make drawings, write the dimensions on each, and then find how many inches of molding are required for each frame.

4. Find the number of inches of molding required for the three frames, allowing 12½ inches as the total waste. Find the number of feet required.

5. How much does the molding cost at 16¢ a foot?

6. The father of the boy living in this room allowed $90.00 for furnishing the room. He bought a couch for $9.75, 2 chairs for $4.25 apiece, a writing table for $18.50, a chiffonier for $16.25, and a rug for $20.75. How much less than $90.00 did these furnishings cost?

*7. How much less than $90.00 was spent on the room if the cost of the book shelves and the picture frames is included?

*8. Plan how to spend $80 in furnishing either a boy's room or a girl's room 12 ft. by 15 ft. Draw the room to a scale of 3 ft. to an inch and then choose furnishings for the room.

V. Summary

[With pencil.]

The total amount allowed for furnishing the house is $850.00. After spending $170.90 on the kitchen and laundry, $385.70 on the living and dining rooms, $95.12 on the girl's room, and $83.95 on the boy's room, how much is left with which to furnish the hall and the parents' room?

92. Review — Progress Score

With the help of these exercises measure your year's work in computing. Try to make 100 points on each exercise, or a total of 400 points. Count for each correct answer the score given in parenthesis below the letter of the problem.

I. Addition

Add:

[Copy problems only when necessary.]

A. 50
(2) 33

B. 65
(2) 29

C. 47
(3) 24
38

D. $2.75
(4) 6.87
4.95

E. 4
(5) 5
7
3
6
9
8
7
4
0
5
7
6

F. 526
(6) 379
850
493
875
639
578
907
869

G. $1\frac{1}{2}$
(5) $1\frac{5}{2}$

H. $\frac{7}{8}$
(6) $\frac{5}{8}$

I. $2\frac{2}{5}$
(4) $4\frac{1}{5}$

J. $3\frac{2}{3}$
(5) $2\frac{1}{3}$

K. $\frac{2}{5}$
(5) $\frac{1}{4}$

L. $\frac{5}{6}$
(6) $\frac{3}{4}$

M. $5\frac{1}{8}$
(5) $4\frac{1}{2}$

N. $6\frac{7}{12}$
(6) $2\frac{1}{4}$

O. 4.27
(5) 3.694
.87

P. .752
(6) .464
.984

Q. $14\frac{5}{8}$
(8) $19\frac{2}{3}$

R. 8.46 + 28.7 = ?
(7)

S. $12\frac{5}{6} + 7\frac{3}{8} + 4\frac{1}{2}$ = ?
(10)

II. Subtraction

Subtract:

[Copy problems only when necessary.]

A. 87
(2) 63

B. 22
(2) 9

C. 74
(2) 28

D. 441
(3) 187

E. $5.00
(4) 2.21

F. 24832
(6) 17904

G. 6000
(5) 2936

H. $\frac{11}{16}$
(5) $\frac{5}{16}$

I. $\frac{5}{12}$
(5) $\frac{1}{6}$

J. $4\frac{7}{8}$
(6) $1\frac{5}{8}$

Subtract:

K. $9\frac{7}{12}$ (7) $2\frac{1}{8}$

L. $14\frac{11}{15}$ (5) $8\frac{3}{5}$

M. 25 (7) $10\frac{3}{5}$

N. $14\frac{1}{8}$ (9) $6\frac{5}{8}$

O. $8\frac{1}{3}$ (10) $2\frac{1}{2}$

P. \$5 − \$2.28 = ? (6)

Q. 8.48 − 2.9 = ? (6)

R. 74.2 − 8.34 = ? (10)

III. Multiplication

Find products: [Copy problems only when necessary.]

A. 90 (2) 5

B. 67 (3) 60

C. 642 (4) 302

D. \$2.75 (6) 174

E. $\frac{3}{4} \times 40$ = ? (4)

F. $\frac{2}{3} \times 16$ = ? (6)

G. $12 \times \frac{7}{8}$ = ? (5)

H. $\frac{5}{7} \times \frac{3}{4}$ = ? (5)

I. $4\frac{1}{3} \times \frac{2}{3}$ = ? (8)

J. $3\frac{3}{5} \times 1\frac{1}{4}$ = ? (9)

K. $14\frac{1}{2}$ (6) 4

L. $11\frac{2}{3}$ (9) 8

M. 24 (7) $2\frac{2}{3}$

N. 12 (9) $6\frac{1}{8}$

O. 428 (5) .03

P. .014 (6) 5

Q. 4.63 (6) 1.8

IV. Division

Find quotients: [Copy problems only when necessary.]

A. $7\overline{)560}$ (2)

B. $5\overline{)\$4.75}$ (4)

C. $9\overline{)3665}$ (4)

D. $71\overline{)1491}$ (3)

E. $31\overline{)6293}$ (5)

F. $57\overline{)2736}$ (8)

G. $63\overline{)56070}$ (9)

H. $875\overline{)32375}$ (9)

I. $12 \div \frac{2}{3}$ = ? (6)

J. $\frac{5}{6} \div 1\frac{5}{12}$ = ? (6)

K. $\frac{4}{5} \div 5$ = ? (6)

L. $8\frac{1}{3} \div \frac{5}{9}$ = ? (8)

M. $3\overline{).789}$ (5)

N. $4\overline{).064}$ (7)

O. $24\overline{)7.92}$ (8)

P. $320\overline{)393.6}$ (10)

93. Problem Test[1]

[Without pencil.]

1. A plan of a rectangular garden 40 feet wide and 60 feet long is to be drawn to a scale of 20 feet to an inch. What should be the width of the plan? The length?

2. A flower bed is 4 feet wide and $10\frac{1}{2}$ feet long. What is its perimeter? Its area?

3. Reduce $1\frac{3}{4}$ feet to inches. $2\frac{1}{3}$ square yards to square feet.

4. At $12\frac{1}{2}$¢ a yard, how many yards of cotton cloth can be bought for $1.00? For $1.50?

5. From a bolt of ribbon containing 12 yards, two pieces are cut. One is $2\frac{3}{8}$ yards long; the other, $2\frac{1}{2}$ yards long. How many yards are left in the bolt?

6. How many yards are left from 5 yards of rope after 2 pieces, each $\frac{3}{4}$ of a yard long, have been cut from it?

7. In buying $4\frac{1}{2}$ yards of muslin at 20¢ a yard, how much change should be received from $1.00?

8. Oranges are selling at 45¢ a dozen. At the same rate, how much must be paid for 8 oranges?

9. The following recipe for cake is to be doubled: $1\frac{1}{2}$ cups of sugar, $\frac{3}{4}$ cups of milk, $\frac{1}{3}$ cup of butter, $2\frac{1}{2}$ cups of flour, 2 teaspoons of baking powder, and 1 teaspoon of vanilla. How much of each ingredient should be used?

10. A carpenter works for 90¢ an hour, from 8 o'clock in the morning until 5 o'clock in the afternoon, with 1 hour off at noon. How much does he earn in a day?

[With pencil.]

11. Find the amount that must be paid for a roast of beef weighing $7\frac{1}{2}$ pounds, selling at 50¢ a pound.

[1] Pupils should be able, also, to answer questions like these: How can you find the area of a room 10 ft. by 12 ft.? The number of inches in $\frac{3}{4}$ of a foot? The cost of 8 articles when the cost of a dozen is known? Drill on these questions should precede the test and cover the same types of problems both with and without numbers.

Find the total amount due for the articles in each of these lists:

12. 1 dishpan @ $1.25.
6 baking tins @ 30¢.
2 muffin tins @ 45¢.
1 broom @ 70¢.
1 dust mop @ 90¢.
2 brushes @ 25¢.

13. 6 tumblers @ 10¢.
12 plates @ 15¢.
1 platter @ 1.25.
6 cups and saucers @ 25¢.
3 pitchers @ 30¢.
3 bowls @ 15¢.

14. Find how much would be left from a ten-dollar bill after paying for the items in problem 13.

15. Out of $50, my father pays a bill for groceries of $24.72 and a meat bill of $9.84. How much has he left?

16. A bedroom requires 4 strips of matting, each $4\frac{1}{2}$ yards long. Find the cost at 60¢ a yard.

17. A rectangular building lot is 40 feet wide and 104 feet deep. What is its value at 15¢ a square foot?

18. Garden markers $6\frac{1}{2}$ inches long are to be cut from a strip of wood 78 inches long. How many can be cut if the markers are made the same width and thickness as the strip of wood?

19. From 30 yards of canvas, three pieces are cut. One piece is $8\frac{3}{4}$ yards long; another, $5\frac{1}{2}$ yards long; and the other, $12\frac{7}{8}$ yards long. Find the length of the piece that is left.

20. A train has a run of 250 miles to make. The first hour it travels 42.8 miles; the second hour, 45.25 miles; the third hour, 47.35 miles. How far from its destination is it at the end of the third hour?

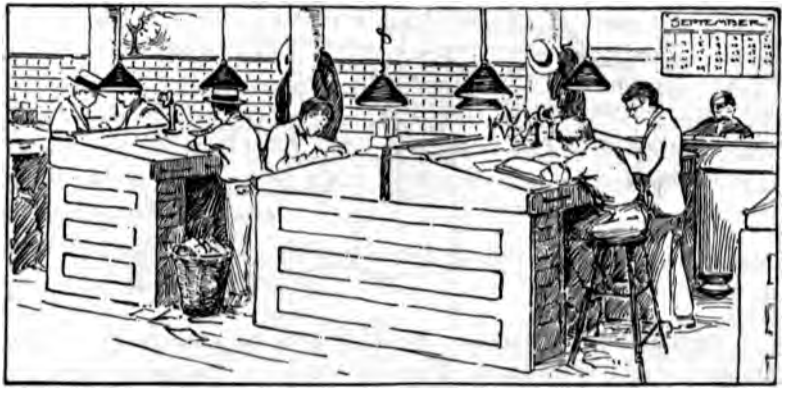
21. A farmer raises 40 acres of wheat yielding 18.25 bushels to an acre. What is the value of the wheat at $2.25 a bushel?

22. A telephone connects two farmhouses $\frac{5}{8}$ of a mile apart. How many feet of wire are required for a single line? Find the cost at $.006 a foot.

PART FOUR

CHAPTER I. BILLS AND ACCOUNTS

1. Keeping a Cash Account



I

The men pictured here are keeping the accounts of a large retail store. It is their business to make a record of the income and expenses of the company and to send out bills to customers. This is done so that there may be no waste in spending money and as little loss as possible in collecting what is due the store.

The following pages contain the part of a bookkeeper's work that every boy and girl should know in order to keep his or her own accounts.

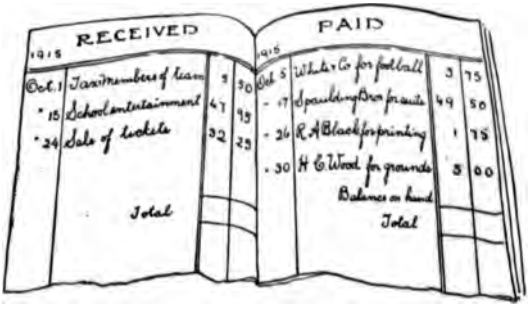
Give reasons why boys and girls, as well as business houses, should keep an accurate record of expenses.

II

[With pencil.]

The account pictured below is a record of receipts and expenditures such as might be kept by the treasurer of a football team. On the left-hand page are written the sums of money received during a month; on the right-hand page, those paid out. Such a record is called a **cash account.**

1. Find, from this account, the total amount received. The total amount paid out.



A cash account is balanced by adding to the sums paid out the amount of money on hand. The sum found by this addition should be the same as the total amount received.

2. For the cash account above, how can we find the amount of money, or balance, on hand? Where should this sum be written? What is the total for each page?

3. Why do you think the sum of money on hand is called the **balance?**

Find the balance for each of the following accounts:

4. A sixth-grade boy had on hand, Jan. 1, $6.24. He received for working Saturday: Jan. 6, $.75; Jan. 13, $.60. He spent, on Jan. 5, $.15 for a compass; Jan. 9, $.20 for paper; Jan. 11, $.90 for a book. He received, Jan. 20, for work, $1.25. He spent, on Jan. 22, $.50 for

a school entertainment; on Jan. 25, $.25 to have his skates sharpened. He deposited, on Jan. 27, $5.00 in a savings bank.

5. The pupils in a school issued a paper. They received $14.65 for advertisements; $8.75 for the sale of copies of the fall number; $14.75 for the winter number; and $17.50 for the spring number. They spent, for paper, $3.07; for postage, $1.24; and for illustrations, $9.50.

6. On the twenty-first of March, a school gave a cake and candy sale. They received from the sale of cake, $16.50; from the sale of candy, $30.47; from the sale of lemonade, $4.25; from the sale of ice-cream, $26.50. Mar. 22, they paid $18.00 for the ice-cream that they had used; Mar. 25, $32.85 for 4 baseball uniforms; Mar. 27, $16.20 for other athletic supplies; Mar. 28, $2.85 for lumber for sand boxes; Mar. 29, $2.75 for a load of beach sand; Mar. 30, $3.20 for a basket ball, and $.75 for a new pane for one broken in a gymnasium window.

7. Margaret N. kept, for her mother, a cash account of the household expenses of the family. The amount on hand, Sept. 1, was $24.65; the amount received was $125.00. From these sums of money was paid, Sept. 1, for rent, $37.50; Sept. 2, August grocery bill, $34.18; Sept. 4, meat bill, $9.72; Sept. 8, gas bill, $2.75; Sept. 9, laundry bill, $4.18; Sept. 15, coal bill, $15.75; Sept. 18, telephone bill, $2.90; Sept. 30, ice bill, $2.50.

8. A cash account kept by a newsboy contained in one week the following items: Paid Brown & Fitch News Company for papers: Oct. 4, 25¢; Oct. 5, 40¢; Oct. 6, 35¢; Oct. 7, 50¢; Oct. 8, 44¢; Oct. 9, 50¢. Received from the sale of papers: Oct. 4, 40¢; Oct. 5, 70¢; Oct. 6, 80¢; Oct. 7, 80¢; Oct. 8, 68¢; Oct. 9, 80¢. Find the cash balance for the week.

9. A farmer had on hand at the beginning of October, $75.50. He received during the month: $15.00, $48.00, $2.75, $10.00, $6.78, $22.45, $125.00, $24.60. He paid out: $4.25, $16.40, $100.00, $25.00, $3.25, $40.00, $12.75.

Find the balance for each of the following accounts, and then

10.

19..... **Received**

Sept.	1	From father, monthly allowance	1	00
"	5	From father, for mowing lawn		25
"	10	From mother, for errand		15
"	18	From Aunt E., for errand		25
"	24	From Uncle J., present	2	50
		Total		

11.

19..... **Received**

Oct.	1	Am't brought forward	2	30
"	1	From father, allowance	1	00
"	8	From mother, for errands		40
"	15	From father, for errands		50
"	25	" " for work on lawn		35
		Total		

explain how each account should be filled out:

19..... **Paid**

Sept.	4	Paint box and brush		50
"	9	Scholar's Companion		25
"	19	Ice-cream		10
"	27	Concert		25
"	30	Birthday present for mother		75
		Balance on hand	.....	.....
		Total		

19..... **Paid**

Oct.	5	Shoes mended		35
"	7	Hair cut		25
"	17	Library fine		08
"	20	Carfare		20
"	30	Savings bank	2	00
		Balance on hand	.....	.....
		Total		

Find the balance for each of the following accounts, and then

10.

19..... **Received**

Sept.	1	From father, monthly allowance	1	00
"	5	From father, for mowing lawn		25
"	10	From mother, for errand		15
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"	24	From Uncle J., present	2	50
		Total		

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"	8	From mother, for errands		40
"	15	From father, for errands		50
"	25	" " for work on lawn		35
		Total		

explain how each account should be filled out:

19..... **Paid**

Sept.	4	Paint box and brush		50
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"	19	Icecream		10
"	27	Concert		25
"	30	Birthday present for mother		75
		Balance on hand	.....	.....
		Total		

19..... **Paid**

Oct.	5	Shoes mended		35
"	7	Hair cut		25
"	17	Library fine		08
"	20	Carfare		20
"	30	Savings bank	2	00
		Balance on hand	.....	.....
		Total		

To make a cash book of your own, first rule a number of sheets according to the form just given, omitting the horizontal lines near the totals; then fasten the sheets together in the form of a book and put in the necessary headings. As sums of money are received or spent, record each item, balancing each page and carrying over to the next page, under "Received," the amount of cash on hand. (See "Am't brought forward" in the second account, No. 11.) Continue this, remembering to start the account for each succeeding month on a new page.[1]

To prevent blotting, in drawing lines with ink, draw the pen along a ruler with the beveled edge held uppermost above the space where the line is to be drawn. To make an even line, draw the entire length of line without lifting the pen.

12. Rule a sheet of paper according to the form given, make a suitable heading, and fill in the space with the items from the problem below; then balance the account.

A sixth-grade girl had on hand, Oct. 1, 1920, $2.18. Oct. 2, she received from her father her monthly allowance of $.75. Oct. 3, she spent $.25 for a school entertainment and $.15 for candy. Oct. 9, she received $5.00 as a birthday present from her aunt. Oct. 12, she spent $.20 for her Sunday School. Oct. 17, she spent $4.25 for a camera. Oct. 20, she earned $.15, washing dishes. Oct. 24, she spent $.10 for postal cards and $.18 for postage stamps. Oct. 29, she lent her brother $1.25.

2. Speed and Accuracy Tests. Group I

The following tests contain the fundamental facts in addition, subtraction, multiplication, and division that are most likely to give trouble in computing. Write answers on the folds of a sheet of paper placed below the problems. Practice on each set of problems until you can reach the standard.[2]

[1] Each pupil in this grade should keep his own actual account or an imaginary one for a number of successive months, allowing his teacher to inspect it at stated periods to see that it is accurately kept.

[2] Other arrangements of these tests may be found on pages 5, 6, and 12.

Test No. 1. Addition. Practice on each set of 10 problems until you can write the correct sums in 25 seconds. Use only a few words. In adding 5, 4, 4, think *9*, *13*, or merely *13*.

Add: [Write answers only.]

1.	4	6	8	5	7	9	4	6	8	5
	4	4	4	5	5	5	7	7	7	6
	5	7	9	4	6	8	5	7	9	4
2.	6	8	5	7	9	4	6	8	5	6
	6	6	8	8	8	9	9	9	4	4
	7	9	4	6	8	5	7	9	7	8
3.	9	7	8	4	5	6	9	7	8	4	6
	4	6	6	6	5	5	5	8	8	8	9
	4	5	6	9	7	8	4	5	6	9	4

Test No. 2. Subtraction. Practice on each set of 9 problems until you can write the correct differences in 15 seconds. In taking 5 from 11, think *6*, not *5 from 11 is 6*.

Subtract: [Write answers only.]

1.	11	13	12	17	16	9	15	16	13
	5	6	7	8	9	0	7	7	5
2.	11	12	13	17	14	15	8	13	14
	6	5	7	9	9	8	0	8	6
3.	13	11	12	14	11	7	12	15	16
	9	4	9	5	7	0	8	9	8
4.	15	11	7	12	14	11	14	13	18
	6	8	7	4	7	9	8	4	9

Test No. 3. Multiplication. Practice on each set of 12 problems until you can write the answers correctly in 1½ minutes. Use only a few words: in multiplying 83 by 5, think: 15, 40, 43, or merely 15, 43.

[With pencil.]

1.	85	97	60	42	80	67
	3	3	3	3	2	2
	90	83	74	56	73	84
	4	4	4	4	5	5
2.	91	65	70	83	45	61
	5	5	6	6	6	6
	92	71	48	35	29	60
	6	7	7	7	7	7
3.	89	90	28	37	46	51
	7	8	8	8	8	8
	80	72	91	45	36	78
	9	9	9	9	9	9

Test No. 4. Division. Practice on each set of 5 problems until you can write the correct quotients in 45 seconds. Divide with only a few words in mind.[1]

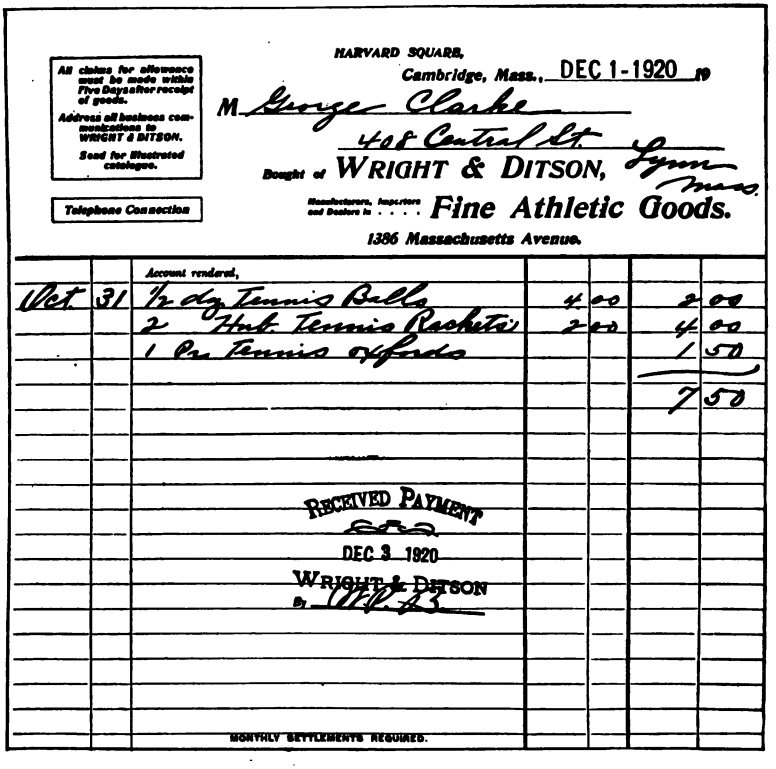
[With pencil.]

1.	3|288	3|249	4|268	5|455	5|375
2.	6|270	6|366	6|432	6|498	6|540
3.	7|175	7|637	7|588	7|511	7|420
4.	8|344	8|736	8|568	8|640	8|520
5.	9|675	9|720	9|549	9|468	9|387

[1] Quotients may be written below dividends, or problems may be copied.

3. Bills and Receipts

(1) The following bill shows that George Clarke bought on October 31, 1920, certain articles from Wright & Ditson, dealers in athletic goods. What were the articles purchased? What shows that the bill has been paid?



All claims for allowance must be made within Five Days after receipt of goods.

Address all business communications to WRIGHT & DITSON.

Send for Illustrated catalogue.

Telephone Connection

HARVARD SQUARE,
Cambridge, Mass., DEC 1-1920 19

M George Clarke
408 Central St. Lynn Mass.

Bought of WRIGHT & DITSON,
Manufacturers, Importers and Dealers in . . . . Fine Athletic Goods.
1386 Massachusetts Avenue.

		Account rendered,				
Oct	31	1/2 doz Tennis Balls	4	00	2	00
		2 Hub Tennis Rackets	2	00	4	00
		1 Pr Tennis Oxfords			1	50
					7	50

RECEIVED PAYMENT
DEC 3 1920
WRIGHT & DITSON
By W. A. S.

MONTHLY SETTLEMENTS REQUIRED.

When a bill is marked "Received payment" and signed, the bill is said to be **receipted.**

Bring receipted bills from home for study.

(2) When a plumber, a carpenter, or other mechanic does work for a person, he presents a bill containing a list of the materials used, with their prices, and a statement of his charges for labor. Study the bill pictured below. What shows that this bill has been paid? Who receipted the bill? Why?

BILL FOR LABOR AND MATERIAL

Port Jefferson, N.Y., Jan. 4, 192-

Mr. Fred. G. Warren

To GEO. F. ELDERKIN, Dr.
Plumber and Gas Fitter

16 Front St.

TERMS CASH

Jan.	2	Solder and Washers		60		
		Labor repairing Pipe	1	50	2	10
		Paid Geo. F. Elderkin				

1. With the bill above as a model, rule a sheet of paper carefully, and then make out a bill to your father, for work done by you about your home. Charge him, for example, for 2 hours of work done on one date and for 3 hours of work done on another. In which double column would you write the different items of your bill? In which the total charge? What two forms of wording could you choose between in receipting the bill?

A receipt for payment, when no bill is presented, may be written as follows:

Denver, Colo., Nov. 2, 1920.

Received of William F. Foster

Twenty-five ~~~~~~~~~~~~~~~~~~~~ $\frac{\times}{100}$ Dollars

for house rent to Nov. 1, 1920.

Martin E. Roberts.

2. What advantage is there in having a bill receipted when paid? Why is it wise to keep receipted bills and receipts?

3. Rule a sheet of paper carefully, using the bill on page 147 as a model; supply the name and address of a boy to whom the goods might be sold; then make out such a bill as Wright & Ditson might send him for the following articles: 1 football at $2.50, 1 football suit at $6.50, 1 sweater at $7.75.

4. Imagine yourself the purchaser of the following bill of goods, find the amount due, and then tell who would receipt the bill: Bought of John Wanamaker, Astor Place, N.Y., 1 camera at $3.50; 1 camera case at $.75; 4 rolls of films at 35¢ a roll; 2 doz. mounting cards at 15¢ a dozen; 1 printing and developing outfit at $1.65.

5. Make out on carefully ruled paper an imaginary bill with yourself as the one who sold goods. Receipt the bill.

6. Write a receipt for $15 paid you by some imaginary person.

Find the amount due:

7. Bought of the Eastern Talking Machine Co., 3 Victor records @ 85¢; 3 double-faced records @ $1.00; 2 Victor records @ $1.50.

Of this number 1 record @ 85¢ and 1 @ $1.50 were returned, and full credit was given.

8. Bought of A. G. Spalding & Co., Nassua St., New York: Aug. 4, 1 catcher's mit at $2.50; Aug. 12, 3 baseballs at $1.25, 2 bats at 75¢; Aug. 25, 1 fielder's glove at $1.50.

9. Bought of John Wanamaker, Astor Place, New York; June 1, 2 blouses at $1.95, 1 pair pumps at $1.90; June 6, 6 handkerchiefs at 12½¢, 6 yd. white Russian cord suiting at 39¢; June 12, 1 pair gloves at $1.23.

10. Bought of Putnam Camping Outfit Company: 1 waterproof tent, 7¼ by 9¾, at $24.20; 1 khaki tent, 9 by 12, at $36.00; 1 tent-fly at $9.60; 4 iron-framed National Spring cots at $4.75 each; 4 mattresses at $7.50 each; 2 camp chairs at 75¢ each; 4 camp chairs at 50¢ each; 1 cooking outfit at $36.50.

11. John Day laid a hardwood floor in my house. He used 156 feet of lumber at 15¢ a foot, 6 lb. of nails at 5¢ a pound, and building paper at 75¢. The job required 24 hours of labor at 90¢ an hour.

12. Morris Clark, an electrician, wired my cottage. He charged me for 325 ft. No. 14 wire at 1½¢ a foot; for 57 porcelain cleats at 2¢ each; for switches, sockets, and tubing, $7.86; and for 19 hours of labor at $1.00 an hour.

*13. R. H. Rice & Co. in repairing a furnace made the following charges: Sept. 28, 16 lb. funnel at 15¢ a pound, 1 damper at 25¢, cement at 10¢, brick at $1.10, 5 hr. of labor at 90¢ an hour; Oct. 3, 5 lb. of lead pipe at 8¢ a pound, 1 trap at $1.00, solder at 20¢, 6 hr. of labor at 90¢ an hour; Oct. 24, 17 lb. galvanized pipe at 20¢ a pound, 8 lb. of black iron at 8¢ a pound, 1 ten-inch tin elbow at $1.00, 1 seven-inch elbow at 75¢, 1½ doz. bolts at 24¢ a dozen, 13 lb. furnace cement at 10¢ a pound, 1 pail of cement at 35¢, 16 hr. of labor at 90¢.[1]

[1] Problems starred are intended as optional work for the more advanced pupils.

4. Speed and Accuracy Tests. Group II

These tests are to help you further in learning to compute accurately and with speed. If, within the time limit, you fail to get the correct answers to all of the problems in a test, practice solving the problems in the set having the same number, then try the test again.

[With pencil.]

Test No. 5. Add. Time limit, $1\frac{1}{2}$ minutes.

3	4	7
7	5	3
6	4	2
5	3	8
4	9	7
3	6	6
6	2	6
8	5	7
8	7	9
7	2	2
4	9	7
7	8	6

Practice No. 5. Practice adding at a steady rate.

1.	9	5	7	2.	6	5	8
	6	4	7		4	7	7
	3	7	5		3	4	2
	0	9	4		2	2	3
	7	6	9		7	3	2
	2	0	6		9	0	7
	5	8	0		8	9	4
	6	7	8		6	1	6
	7	8	7		8	6	1
	4	2	8		6	6	0
	7	6	9		3	5	8
	5	9	4		5	8	7

Test No. 6. Subtract. Time limit, 1 minute.

[With pencil.]

7458	25234	13600	5000	97430
2793	7850	4743	2143	2374

Practice No. 6. Practice subtracting, naming differences only.

1.	4876	35257	17500	8000	67540
	2438	8970	9621	3166	3497
2.	5274	24132	12200	7000	48350
	3626	8060	3137	2354	2947
3.	9423	73205	14300	4000	86540
	2137	7490	8728	3792	2472

4. 7235	30407	16400	9000	59360
4658	7940	9644	4218	3295

Test No. 7. Add. Time limit, 2 minutes.

654	548
328	637
567	789
879	654
634	376
258	529
540	486
307	379
566	275

Practice No. 7. Practice adding rapidly but carefully.

1. 327	963		2. 215	738
869	278		327	679
347	677		865	543
253	825		978	786
687	348		650	279
476	699		437	545
809	756		658	578
276	307		213	670
148	298		879	439

3. 789	345	4. 456	567		5. 245	567
476	324	654	765		35	820
456	434	345	657		156	508
654	245	665	566		275	385
445	444	456	767		437	258
566	235	565	456		136	478
506	924	968	180		987	543
656	843	459	245		956	238
255	568	567	104		858	675

Test No. 8. Multiply. Time limit, 4½ minutes. [With pencil.]

2876	1790	3965	4408
59	460	207	248

Practice No. 8. Practice multiplying, thinking as few words as possible. Place each figure carefully.

1. 7243	5280	1728	2106
28	240	306	327
2. 6975	4790	1492	4072
76	360	607	428

3. 9782	6380	3267	3209
59	750	509	179
4. 8769	7260	4178	6708
87	590	403	396

Test No. 9. Divide. Time limit after copying problems, 6 minutes.

[With pencil.]

64)19457	38)24320	49)18306	173)13667

Practice No. 9. Practice dividing.

1. 72)14761	68)36040	56)26768	113)7784
2. 83)49971	57)41040	38)26372	164)9348
3. 65)45569	29)26390	78)45396	175)8575
4. 91)73166	78)49920	67)31021	154)5698
5. 82)49939	49)41650	89)35066	143)12727

5. Finding Averages

Three books were bought for $3.75. What was the average amount paid for each book?

An average is found by making an equal division, or distribution, of a number. The average amount paid for each book was $\frac{1}{3}$ of $3.75, or $1.25. The books, however, might have been different prices: one might have been bought for $1.00, another for $2.00, and the other for $.75.

[Without pencil.]

1. What is the average amount paid for each when 2 pictures are bought for $4.40? When 3 chairs are bought for $9.60?

2. Coal to supply a family for 3 months costs $39.00. Find the average cost per month.

3. A telephone contracted for at $30.00 a year costs on an average how much per month?

II

The charges on my gas bills for one summer were as follows: for June, $2.40; for July, $2.20; for August, $2.30. What was the average charge per month?

$2.40
2.20
2.30
3) $6.90
$2.30 Average

The three bills would all have been for the same amount, if 10¢ had been taken from the June bill and added to the July bill. The evened-up, or average, bill per month was, therefore, $2.30. To find such an average, it is customary to find the sum of the numbers to be averaged, and then to divide this sum by the total number of items included.

[With pencil.]

1. During a summer vacation, a boy earns, in the first month, $14.50; in the second month, $18.50. What were his average earnings per month?

2. A family pays for groceries: in September, $24.70; in October, $21.50; in November, $25.40. Find the average amount paid per month.

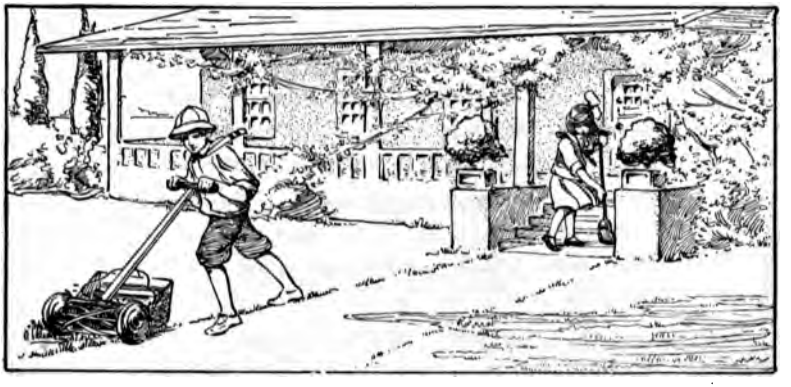
3. The bills covering a year's clothing for a family gave as a total for the father's clothing, $150; for the mother's clothing, $174; for the son's, $92.60; for the daughter's, $128.75. What was the average yearly cost per person for clothes?

4. A man's traveling expenses for six months were as follows: in January, $3.40; in February, $6.75; in March, $5.80; in April, $6.95; in May, $9.40; in June, $8.65. Find the average expense per month.

5. Solve three problems of your own in finding averages.

*6. A year's expenses for a family of five are as follows: for food, $540; for rent, $350; for clothes, $245; for coal, wood, and gas, $120; for laundry, $65; for church, $40; for insurance, $130; for doctor's attendance, $10; for magazines, papers, and books, $24.50; for incidentals, $47.50. Find the average expense per month for each member of the family.

6. Boys and Girls Earning Money



Since the Great War boys and girls throughout the country are learning habits of thrift. What are some of the ways by which boys and girls in your part of the country can earn money?

What are some of the best ways of saving money?

[Use pencil only when needed.]

1. A southern girl raised 192 chickens valued at $264.24. The expense of raising the flock was $103.80. What was her net profit?

2. A New England boy with a small equipment made 60 pounds of maple sugar and $4\frac{1}{2}$ gallons of sirup. What was their value with maple sugar selling at 40¢ a pound and sirup a $2.75 a gallon?

3. A boy in the northwestern part of the country made a profit of $65 on a tenth of an acre of beans. He spent $16 of this money for clothes, $7 for rabbits, and $2 for amusement. The rest he gave to his father to help buy an automobile in which to go to school. How much did he give his father?

4. A girl in the southwestern part of the country got permission from her father to sell fruit to people passing in automobiles. In one day she sold 10 boxes of peaches at 35¢, 12 boxes of apricots at 45¢, and 5 boxes of plums at 60¢. How much money was taken?

5. A boy belonging to a corn club in the middle west sold his corn crop of 48 bushels for $57.60. How much did he receive a bushel?

6. Two girls in the middle west decided to raise chickens. They bought 3 hens at $1.75 apiece, 3 dozen eggs for setting at 70¢ a dozen, lumber for $2.60, and 20 yards of wire netting at 30¢ a yard. How much did it cost the girls to start in the business?

7. Out of the 3 dozen eggs purchased, $\frac{3}{4}$ of the number hatched. Two of the chickens were lost. At the end of 12 weeks, the girls sold those that were left at an average price of 96¢ each. How much did the girls receive for the chickens?

8. Besides scraps, the girls fed the chickens each week 8 lb. of cracked wheat purchased at 5¢ a pound. Find how much the food for the 12 weeks cost.

9. The money received from the sale of the chickens was how much greater than the expense for the eggs and the food?

10. From a small garden, the following vegetables were sold: 180 qt. of beans at 10¢ a qt.; 12 heads of cabbage at 15¢ a head; 18 doz. ears of corn at 20¢ a dozen; 60 heads of lettuce at 8¢ a head; 30 bunches of onions at 10¢ a bunch; 5 bunches of radishes at 5¢ a bunch; and 150 lb. of tomatoes at 8¢ a pound. The expenses for this garden came to $14.23. How much money was cleared?

11. George Mason is earning money with which to pay his expenses at a summer camp for boys. By taking care of lawns, the first week in one month he earned $1.75; the second week, $.90; the third week, $2.15; the fourth week, $1.60. What were his average earnings per week? At the same average rate, how many weeks will it take him to earn $50.00?

*12. Roland Smith is earning money with a paper route to help pay his way through college. His income from his route is $3.65 a week; his expenses are $2.35. At this rate, how much money does he save in 1 year? If, each succeeding year, he saves $1\frac{1}{2}$ times as much as in the year preceding, how much will he have by the end of 4 years?

CHAPTER II. TRAVEL AND TRANSPORTATION

7. The Use of Decimals

I. Review

In writing many facts connected with travel and transportation, decimals are used. Passenger and other rates are expressed in dollars and cents; railway distances and records in travel are expressed in miles and the decimal parts of a mile; the weights of produce shipped are expressed in pounds, in hundredweights, and in tons and their decimal parts.

1. Explain how to write decimally: $\frac{1}{10}$ of a mile; $\frac{3}{10}$ of a foot; $\frac{25}{100}$ of a dollar; $\frac{125}{1000}$ of a ton.

2. In reading decimals, what denominator is given to a decimal containing one figure? To one containing two figures? To one containing three figures?

Read:

3. .1; .3; .4; .9.
4. .01; .05; .2; .15.
5. .7; .07; .007.
6. .008; .025; .324.
7. .75; .125; .308.
8. .08; .6; .375.

In reading such a number as 12.327, the word *and* is used between the integer and the decimal only. 12.327 is read: twelve *and* three hundred twenty-seven thousandths.

Read:

9. 2.3; 2.03; 2.003.
10. 4.25; 18.75; 14.8.
11. 124.5; 175.42; 81.06.
12. 5.004; 6.011; 18.125.
13. 7.005; 8.035; 9.735.
14. 1148.8; 114.88; 11.488.

Read:

15. Some of the fast warships in the United States Navy travel at the rate of 22.5 knots or 25.911 miles, per hour.

16. One of the best records in railway travel ever made in the United States was 107.9 miles per hour; one of the best records in airship travel, 160.24 miles per hour.

17. The distance covered by a cannon ball sent from a warship by a gun with a 5-inch muzzle is 6.25 miles; by a gun with a 10-inch muzzle, 10.8 miles.

18. To write .12 requires a decimal point and two figures. To write $\frac{12}{100}$ requires a line and how many figures?

19. Compare the number of figures used in writing .3 with the number used in writing $\frac{3}{10}$. Compare the number used in .125 with the number used in $\frac{125}{1000}$.

20. What advantage is there in writing as decimals such fractions as $\frac{12}{100}$, $\frac{3}{10}$, and $\frac{125}{1000}$?

Write as decimals:

21. $\frac{7}{10}$, $\frac{5}{10}$, $1\frac{7}{10}$, $14\frac{5}{10}$.

22. $\frac{25}{100}$, $\frac{5}{100}$, $1\frac{25}{100}$, $8\frac{5}{100}$.

23. $\frac{225}{1000}$, $\frac{63}{1000}$, $\frac{7}{1000}$.

24. $\frac{8}{10}$, $\frac{8}{100}$, $\frac{8}{1000}$.

25. $124\frac{9}{10}$, $65\frac{38}{100}$, $42\frac{7}{100}$.

26. $1\frac{125}{1000}$, $16\frac{8}{1000}$, $12\frac{25}{1000}$.

27. $9\frac{8}{10}$, $114\frac{5}{100}$, $46\frac{75}{100}$.

28. $24\frac{7}{100}$, $18\frac{25}{1000}$, $120\frac{5}{1000}$.

II. Decimals of Six Orders

Tenths	Hundredths	Thousandths	Ten-thousandths	Hundred-thousandths	Millionths.
2	1	3	4	6	7

The different decimal orders are named according to the part of a unit that they express. After millionths come ten-millionths, hundred-millionths, billionths, and so on. The orders beyond millionths, however, denote such small fractional parts of a quantity that they are practically never used.

1. Beginning with tenths, learn in order the names of the decimal places in the number just given.

2. What name is given to the third decimal place, counting from the decimal point? To the sixth?

3. Which place is called ten-thousandths? Which, hundred-thousandths? Which, millionths?

4. For practice in learning the names of the different orders, write six ciphers on a blackboard in this form: .000000. Point to the different orders and ask your classmates to name them.

A number written as a decimal is read as a whole number and then given the denomination of the last figure at the right.

.0105	is read	one hundred five ten-thousandths.
.04065	is read	four thousand, sixty-five hundred-thousandths.
8.000079	is read	eight and seventy-nine millionths.
4.001012	is read	four and one thousand twelve millionths.

Read, naming the orders only when necessary:

5. .08	14. 144.075	23. .040125
6. .235	15. 28.0025	24. .075025
7. .0004	16. 1742.84	25. 9.99375
8. .0124	17. 934.482	26. 84.878658
9. .0507	18. 2749.375	27. 978.999
10. 3.25	19. 452.0625	28. 8742.97654
11. 7.003	20. 12,148.875	29. 14,976.679
12. 18.075	21. .09125	30. 9,075.8045
13. 9.0124	22. .009125	31. 907.58045

In writing decimals, it is convenient to know that there are as many places in the decimal as there are ciphers in its denominator: $\frac{75}{1000}$ requires three places when it is written as a decimal; $\frac{3}{1000000}$ requires six.

Write as decimals:

32. $\frac{25}{1000}$, $\frac{25}{10000}$, $\frac{25}{100000}$, $\frac{225}{10000}$, $\frac{225}{100000}$, $\frac{225}{1000000}$, $5\frac{14}{1000}$, $5\frac{14}{10000}$, $5\frac{14}{100000}$.

33. 38 thousandths; 38 ten-thousandths; 17 and 38 ten-thousandths.

34. 1045 hundred-thousandths; 1045 millionths.

35. 945 and 2409 millionths.

36. One thousand three hundred twelve and seventy-five hundredths.

37. One thousand twelve and seventy-five thousandths.

38. Ninety-five millionths.

39. Four thousand two hundred ninety-five millionths.

40. Eight and four thousand ninety-five millionths.

41. Two hundred nine and seven thousand eight hundred twelve hundred-thousandths.

8. Addition and Subtraction of Decimals

I. Review

The railway distance from New York to Buffalo is 427.5 miles, and from Buffalo to Chicago it is 535.2 miles. How much less than 1000 miles is the distance from New York to Chicago by way of Buffalo?

427.5 mi. + 535.2 mi. = ?

$$\begin{array}{r} 427.5 \\ \underline{535.2} \\ 962.7 \end{array}$$

1000 mi. − 962.7 mi. = ?

$$\begin{array}{r} 1000 \\ \underline{962.7} \\ 37.3 \end{array}$$

Difference = 37.3 mi.

[Without pencil.]

1. In the addition and subtraction of decimals, why are the numbers written so that the decimal points fall under each other? Where is the decimal point placed in the sum?

2. In the second part of the solution of the problem above, what

figure was mentally supplied above the 7 at the right of the number 1000? Where does the decimal point belong in the number 1000? Why is it possible to place any number of zeros at the right of a decimal point?

[With pencil.]

3. Find the sum of .332, .28, .346, .64, and .3764. Of 8.42, 9.375, 6.28, 3.275, and 9.384. Of 24.879, 8.49, 27.6, 324.9, 48, 77.06, and 9.015.

4. Subtract: .372 from .698; .279 from .8946; 8.75 from 9.96; 2.439 from 5.85; 6.27 from 9.9; and 3.264 from 8.

5. In traveling from Chicago to New Orleans, the distances covered are: from Chicago to Cairo, 363.57 mi.; from Cairo to Memphis, 170.4 mi.; from Memphis to New Orleans, 395.99 mi. Find the total distance covered.

6. The railway distance from New York to St. Louis is 1059.1 mi.; from New York to Indianapolis, 818 mi. How many miles farther from New York is St. Louis than Indianapolis?

7. The coal cars in a train to be hauled from Lehigh County, Pennsylvania, to New York City weigh as follows: 50.35 tons, 61.473 tons, 48.735 tons, 43.625 tons, 54.57 tons, 62.498 tons, 59.63 tons, 48.756 tons, 54.271 tons, 60.693 tons. What is their total weight?

8. The first car when loaded weighs 50.35 tons; when unloaded, 18.426 tons. The second car when loaded weighs 61.473 tons; when unloaded, 20.289 tons. The third car when loaded weighs 48.735; when unloaded, 19.865 tons. What is the total weight of the coal carried in the three cars?

II

Add:

1. .24, .325, .18, .127.
2. .324, .1252, .375, 2.324, 4.632.
3. 2.43, 3.275, 4.8, 3.65, 4.236.
4. 24.375, 8.64, 9.278.
5. .48, .235, .8423, .62538.
6. 18, 34.5, 2.756, 3.2496.

7. 275, 392.5, 84.65, 38.247, .396.

8. .0025, 3.245, .03245, 275.6, 3294.

9. .007, .00295, 8.75, 962.845, 4.2987, .436.

Subtract:

10. 1.24 from 12.47.
11. .8229 from 1.6387.
12. .24 from 3.479.
13. 3.092 from 8.27.
14. 1.27 from 4.2.
15. 3.75 from 18.
16. 8.47 from 9.628.
17. 54.125 from 100.2.
18. 5.625 from 27.9.
19. 18.372 from 60.

20. From the sum of 4.853, 64.75, 91.8, and 434.625, subtract the sum of 14.375, 9.425, and 114.9.

9. Multiplication with Decimals

I. Review

The average cost of sending a ton of freight a mile in the United States is $.0075. At this rate, what is the cost of sending a car containing 22.4 tons of coal a distance of 1 mile? A distance of 91.4 miles?

(1)

$.0075 × 22.4 = ?

```
  $.0075
    22.4
  ------
     300
    150
   150
  -------
 $.16800
```

Cost for 1 mi. = $.168, or practically $.17.

(2)

$.168 × 91.4 = ?

```
  $.168
   91.4
  -----
    672
   168
  1512
 -------
 $15.3552
```

Cost for 91.4 mi. = $15.36.

[Without pencil.]

1. Compare, in the first solution above, the number of decimal places in the product with the sum of those in the multiplicand and

the multiplier. Do the same with the decimal places in the product of the second solution.

2. Give directions for pointing off the number of decimal places in a product.

3. How many decimal places should be pointed off in the product found by multiplying 1.25 by .5? By multiplying 275 by .04? By multiplying .246 by $1.6\frac{2}{3}$?

4. In writing the final answer for the first problem above, \$.168 was called \$.17. This was because the number of mills was over half a cent in value. In writing the final answer in the second problem, why was \$15.3552 called \$15.36?

[With pencil.]

5. Multiply 4.23 tons by 8. .024 miles by .03. \$7.65 by $.03\frac{1}{3}$.

6. An airship traveling at the rate of 71.25 miles per hour can cover the distance between New York and Washington in 3.2 hours. How far apart are the two cities?

7. An express train traveling at the rate of 63.2 miles per hour can cover the distance between Chicago and Washington in 12.5 hours. The distance to Washington from Chicago is how much greater than the distance to Washington from New York?

8. When railway mileage costs \$.025 a mile, how much does it cost to ride 67 miles? To ride 750 miles?

Multiply:

9. 175 by .2.	14. .3 by .3.	19. 240 by $.16\frac{2}{3}$.
10. 425 by .25.	15. .25 by .2.	20. 450 by $.83\frac{1}{3}$.
11. 82.8 by 1.2.	16. .23 by .21.	21. 36 by $.2\frac{1}{3}$.
12. 3.75 by .8.	17. .025 by .03.	22. 99.9 by $.11\frac{1}{9}$.
13. 87.25 by .75.	18. .009 by .6.	23. .009 by $1.3\frac{1}{3}$.

*24. Multiply the sum of 4.875, 25.35, and 109.5 by $.004\frac{2}{3}$.

II. Multiplication of a Decimal by Ten or a Multiple of Ten

A merchant pays $.15 apiece for delivery of parcels out-of-town. How much does it cost him to send 10 parcels? To send 100?

$$\begin{array}{r} \$.15 \\ 10 \\ \hline \$1.50 \end{array} \qquad \begin{array}{r} \$.15 \\ 100 \\ \hline \$15.00 \end{array}$$

1. How many decimal places to the right is a decimal point moved in multiplying a number by 10? By 100?

2. Multiply $.25 by 1000. How many decimal places to the right is a decimal point moved in multiplying a number by 1000?

To multiply a decimal by ten or a multiple of ten, move the decimal point as many places to the right as there are zeros in the multiplier.

[Use pencil for writing answers only.]

3. Multiply $2.25 by 10; 1.75 lb. by 100; .125 mi. by 1000.

4. The United States has .08 of a mile of railway for each square mile of territory. This is how many miles for each 100 sq. mi.?

5. Canada has .006 of a mile of railway for each square mile. This is how many less, for each 100 sq. mi., than the United States has?

Find the products of:

6. 8.5×10.	10. 2.25×100.	14. $.375 \times 1000$.
7. 93.4×10.	11. 24.75×100.	15. 2.114×1000.
8. 217.3×10.	12. $.65 \times 100$.	16. $.4375 \times 1000$.
9. 3.725×10.	13. 1.324×100.	17. 5.2342×1000.

10. Division of Decimals

I. Division of a Decimal by an Integer

What is $\frac{1}{2}$ of 42 apples? Of 42 hundredths? Of .42?

$$\begin{array}{r} \text{21 apples} \\ 2\overline{)\text{42 apples}} \end{array} \qquad \begin{array}{r} \text{21 hundredths} \\ 2\overline{)\text{42 hundredths}} \end{array} \qquad \begin{array}{r} .21 \\ 2\overline{).42} \end{array}$$

1. In finding a part of a quantity by division, the quotient has the same name or denomination as what other term?

How many feet in $\frac{1}{4}$ of 54.8 ft.? In $\frac{1}{24}$ of the same length?

$\frac{1}{4}$ of 54.8 ft. = ?

```
   13.7
4 | 54.8
```

$\frac{1}{4}$ of 54.8 ft. = 13.7 ft.

$\frac{1}{24}$ of 54.8 ft. = 2.283 + ft.

$\frac{1}{24}$ of 54.8 ft. = ?

```
     2.283 +
24 | 54.8
     48
     ----
      68
      48
     ----
      200
      192
     ----
        80
        72
     ----
```

In dividing a decimal by an integer, point off as many places in the quotient as there are decimal places in the dividend.

In the division of decimals, for most purposes it is not necessary to carry the quotient more than three places. The sign + is used to indicate that if the division were carried further, additional figures in the quotient would be required. $54.8 \div 24 = 2.283\frac{1}{3}$, or 2.283 +.

[With pencil.]

2. Divide: \$6.732 by 3; 19.334 ft. by 4; 69.09 tons by 32; 10,116 miles by 4215.

3. The weights of three loads of coal are as follows: 2.125 tons; 1.75 tons; 2.625 tons. Find the average weight.

4. A motor truck delivers in a day 40 tons of coal at a cost of \$16.75. This is a cost of how much per ton?

5. It costs \$30.00 to deliver the same amount of coal by horse and wagon. Find how much is saved per ton by using the motor truck.

Divide:

6. 4.95 by 2.
7. 19.08 by 6.
8. 36.1 by 4.
9. .1125 by 9.
10. .03 by 8.
11. .0175 by 7.
12. 52.5 by 21.
13. 100.5 by 25.
14. 64.8 by 32.
15. 2.5625 by 41.
16. 3680 by 640.
17. 14355 by 3480.

II. Division of a Decimal by Ten or a Multiple of Ten

What is $\frac{1}{10}$ of 752.5 pounds? $\frac{1}{100}$ of the same weight? $\frac{1}{1000}$?

752.5 ÷ 10 = ?	752.5 ÷ 100 = ?	752.5 ÷ 1000 = ?
75.25	7.525	.7525
10)752.5	100)752.5	1000)752.5

[Without pencil.]

1. How many places to the left is the decimal point moved in dividing the number above by 10? By 100? By 1000?
2. Divide by 10: 2.5; 3.75; 425.8; 83.75; 2.425; .625.
3. Divide by 100: 24.5; 275.3; 28.42; 72; 4.5; .5; .25.
4. Divide by 1000: 125.5; 324; 275.34; .8; .75; 34.275.
5. Divide by 2000: 48,658; 6,540; 874; 452; 134; 176; 154.

III. Division by a Decimal[1]

(1)

3	3	3
2 ft.) 6 ft.	2 tenths) 6 tenths	.2) .6
2	2	2
4 hr.) 8 hr.	4 hundredths) 8 hundredths	.04) .08

In dividing one quantity by another of the same name or denomination, the quotient is an integer when, as in the problems above, the division comes out even.

Find the quotients:

1. .3)$\overline{.6}$ .2)$\overline{.4}$ .3)$\overline{.9}$
2. .02)$\overline{.08}$ .05)$\overline{.15}$
3. .07)$\overline{.21}$ .003)$\overline{.009}$
4. .025)$\overline{.075}$ .022)$\overline{.088}$

[1] A popular but less simple method of explaining the placing of the decimal point in the quotient is called "Clearing the Divisor" — .625 ÷ .25 = ? If there were no decimal place in the divisor (.25), this problem should be solved in the way that all problems are solved when the divisor is a whole number. The question then arises as to the possibility of making the divisor a whole number. Since multiply-

(2)

How many times is .25 miles contained in .625 miles?

.625 ÷ .25 = ?

```
      2.5
.25|.62v5
    50
    125
    125
```

Notice, in dividing .62 by .25, that the terms have the same denominator, and that the quotient is the whole number 2; also, that further division gives the decimal, 5 tenths.

.625 mi. ÷ .25 mi. = 2.5.

.024 ÷ .8 = ?

```
   .03
.8|.0v24
```

.7865 ÷ .005 = ?

```
   157.3
.005|.786v5
```

960 ÷ .32 = ?

```
   3000
.32|960.00v
```

In dividing a number by a decimal, point off with a carat (v) a number of decimal places in the dividend equal to those in the divisor; then place the decimal point in the quotient directly above the carat.

[With pencil.]

First place the decimal point in the quotients and then perform the following divisions:

1. .4|.976
2. .3|8.64
3. .24|.576
4. 3.3|6.963
5. .25|6.775
6. .02|.9768
7. .003|5.7855
8. 2.5|.0075

Divide:

9. .2583 by 2.1.
10. .672 by 3.2.
11. .9951 by .31.
12. 4.686 by 2.2.
13. .6594 by .21.
14. .74904 by .32.
15. 159.375 by 37.5.
16. 36 by .12.
17. 840 by .42.
18. .00492 by .123.

ing both dividend and divisor by the same number does not alter the value of a quotient, it is possible to make the divisor .25 a whole number by multiplying it by 100, provided we also multiply the dividend .625 by 100. .25 × 100 = 25, .625 × 100 = 62.5. .625 ÷ .25 = 62.5 ÷ 25. The rule for this method is: In dividing a number by a decimal, clear the divisor of its decimal by moving the decimal point in both dividend and divisor the necessary places to the right, and then proceed as in the division of a decimal by a whole number.

This method may be used if the teacher prefers it.

IV. Exercises for Skill

[With pencil.]

Practice on each set of problems below until you can get the right figures in the quotients and the decimal points correctly placed.

A. 1. $4\overline{).544}$
2. $8\overline{)1.976}$
3. $6\overline{)7.56}$
4. $5\overline{)27.45}$
5. $3\overline{)157.2}$
6. $33\overline{)7.029}$
7. $24\overline{)50.88}$
8. $321\overline{)995.1}$

B. 9. $.7\overline{).784}$
10. $.6\overline{)9.72}$
11. $.8\overline{)98.736}$
12. $.21\overline{)6.783}$
13. $4.1\overline{)94.71}$
14. $32.3\overline{)7.752}$
15. $2.25\overline{)9.225}$
16. $.375\overline{)7.875}$

C. 17. $.2\overline{)8.6}$
18. $.4\overline{)73.6}$
19. $.7\overline{)996.1}$
20. $.31\overline{)93}$
21. $.43\overline{)13.76}$
22. $2.4\overline{)33.6}$
23. $3.2\overline{)259.2}$
24. $2.25\overline{)69.75}$

D. 25. $.8\overline{)96}$
26. $.31\overline{)1426}$
27. $.32\overline{)7392}$
28. $2.2\overline{)528}$
29. $37.5\overline{)750}$
30. $22.5\overline{)4725}$
31. $1.25\overline{)4125}$
32. $.625\overline{)76}$

E. 33. $.05\overline{)3765}$
34. $.04\overline{)8.688}$
35. $.03\overline{)76.89}$
36. $.007\overline{)1.491}$
37. $.025\overline{)7.775}$
38. $.021\overline{)68.25}$
39. $.032\overline{)137.6}$
40. $.025\overline{)168}$

F. 41. $2\overline{).1574}$
42. $3\overline{).0129}$
43. $21\overline{).7434}$
44. $.6\overline{).0492}$
45. $.41\overline{).00984}$
46. $4.8\overline{).0096}$
47. $2.4\overline{).0288}$
48. $3.7\overline{).01887}$

G. Divide: 945 by 42; 152 by 32; 1518 by 300; 1494 by 2000.

11. Test and Graded Practice

With the help of this test find out and overcome your difficulties with decimals. If you fail to get the right answer to a problem in the test, practice solving the problems in the set having the same letter, then try the problem again.

Test No. 10.

[With pencil.]

A. Write as decimals $1\frac{7}{1000}$, $12\frac{25}{10000}$.

B. 2.875 + 3.75 + 19.8 + 75 = ?

C. 24.275 − 5.48 = ?

D. 8 − 3.42 = ?

E. 4.87 × 2.9 = ?

F. .124 × .05 = ?

G. 48.76 ÷ 25 = ?

H. 37.65 ÷ .05 = ?

I. 1863 ÷ .81 = ?

J. 13648 ÷ 64 = ?

Practice

[With pencil.]

A. Write as decimals: $3\frac{7}{100}$, $2\frac{4}{1000}$, $\frac{2125}{10000}$, $\frac{125}{10000}$, $\frac{25}{10000}$, $7\frac{25}{10000}$

B. Add:

1. .375, .42, .143.
2. 2.42. 34.5, 32.75.
3. 4.65, .075.
4. 5.043, .057, 12.

C. Subtract:

5. .324 from .748.
6. .38 from .962.
7. 2.48 from 8.764.
8. 4.8 from 18.75.

D. Subtract:

9. 2.72 from 8.4.
10. 24.118 from 36.5.
11. 4.7 from 16.
12. 5.37 from 14.

E. Multiply:

13. 24.3 by 22.
14. 78.425 by 4000.
15. 360 by .25.
16. .075 by 4.25.
17. 18.5 by .008.

F. Multiply:

18. .175 by .3.
19. 2.4 by .04.
20. .015 by .21.
21. .125 by .03.

G. Divide:

22. 4.75 by 5.
23. 18.64 by 4.
24. .0462 by .22.
25. .0075 by 2.5.

H. Divide:

26. 7.58 by .08.
27. .675 by .005.
28. 5.39 by .23.
29. .992 by .032.

I. Divide:

30. 96.64 by .302.
31. 547.5 by .25.
32. 16.8 by .014.
33. 968 by .22.
34. 1266 by .075.

J. Divide:

35. 310 by 24.
36. 477 by 36.
37. 678 by 48.
38. 2430 by 324.
39. 846 by 2000.
40. 764 by 3000.
41. 685 by 5000.

12. Owning an Automobile

[Use pencil only when needed.]

1. The following articles are bought for an automobile: 2 new tires at $24.50 each; 2 inner tubes at $3.50 each; 1 spark plug at $1.00. What is their cost?

2. I have put into my car 10 gallons of gasoline at 28¢ a gallon and 2 quarts of oil at 25¢ a quart. In paying for them, what change should I receive from a five-dollar bill?

3. The small mileage register on my car reads 15.7 miles when I start on a trip and 98.0 miles when I return. How long was the trip?

4. I travel 77.5 miles in 4 hours. This is approximately how many miles an hour?

5. Traveling at an average rate of 16 miles an hour, at what time in the morning must I start on a trip 120 miles long in order to reach my destination at half past four o'clock in the afternoon?

6. My car makes 20 miles to a gallon of gasoline. The cost is how much per mile with gasoline selling at 28¢ a gallon?

7. I find that the cost per mile of my car is as follows: for tires, $.019; for gasoline, $.014; for oil and other lubricants, $.001; for repairs, $.011; for insurance, interest, depreciation, and other expenses, $.025. What is the total cost per mile?

8. What is the cost per mile for tires when a set of tires costing $120 are good for 6000 miles?

9. Find the total cost per mile when in one season the expenses for a car come to $742 and the distance covered is 8000 miles.

10. Find the differences in the cost per mile between a small car covering 6000 miles at a cost of $450 and that of a larger car covering 6500 miles at a total cost of $988.

*11. Make and solve 3 problems of your own from facts that you know about automobiles.

13. Planning Journeys

[Use pencil only when needed.]

1. Find the cost of a mileage book containing 500 miles at $.03 a mile. At $.025 a mile.

2. A single ticket between two places 65 miles apart costs $1.80; the round-trip ticket, $3.00. How much is saved on a round trip by buying the round-trip ticket instead of two single tickets?

3. The cost of the round-trip ticket is how much less expensive than mileage at $.03 a mile?

4. The fare between two places is $3.70. Find the change from a ten-dollar bill in buying one full-fare and three half-fare tickets.

5. Round-trip excursion tickets are advertised at $1\frac{1}{3}$ the regular fare with an additional fee of $2.00. At this rate, how much expense is saved on a round trip by two persons if each buys an excursion ticket instead of two single-fare tickets at $16.50 apiece?

6. A journey at a distance is planned. Find the cost of 3 meals in a dining car at $.75 apiece and an upper berth in a sleeping car. Sleeping-car rates: $4.50 for a lower berth; $\frac{4}{5}$ as much for an upper berth.

7. The journey is to be made over three railroads. The distance on one line is 241.9 miles; on another line, 140.5 miles; and on the other, 175.8 miles. This route is how much shorter than one covering a distance of 754 miles?

8. The distance between two places is 292.5 miles. Find how much longer it will take an automobile to make the trip, traveling at 19.5 miles an hour, than the steam cars, which make the journey in $7\frac{1}{2}$ hours.

9. A fast train covers a distance of 275.8 miles in $4\frac{1}{2}$ hours; a slow train, the same distance in $6\frac{1}{4}$ hours. Find the difference in the rate of travel.

*10. The railway distances from your town or city to others may be

found in complete railway time tables. Make a list of several of these distances and use them for problems.

*11. With the help of local rates, compare the cost of the different kinds of tickets to neighboring points of interest.

14. Great Travel Routes

I. Railway Routes in the United States

[With pencil.]

1. Two of the most traveled long-distance routes in our country are that between San Francisco and New York by way of Chicago, and that between Fort Worth, Texas, and New York by way of Kansas City and St. Louis.

With the help of the following tables, find the distance to New York traveled (1) by a carload of fruit in being hauled from San Francisco; (2) by a carload of cattle in being hauled from Fort Worth, Texas.

SAN FRANCISCO TO NEW YORK		FORT WORTH, TEXAS, TO NEW YORK	
San Francisco to Ogden	786	Fort Worth to Kansas City	591
Ogden to Omaha	1000	Kansas City to St. Louis	298
Omaha to Chicago	492	St. Louis to Indianapolis	242
Chicago to Buffalo	535	Indianapolis to Pittsburgh	371
Buffalo to New York	427	Pittsburgh to New York	439

2. With the help of the first table, find how much longer the distance is between San Francisco and Chicago than between Chicago and New York.

3. Traveling at the rate of 30 miles an hour, how many hours are required by a fast freight to cover the distance between San Francisco and Chicago? Between Chicago and New York?

4. With the help of the second table, make and solve problems comparing the distances from one point to another.

5. A passenger train traveling at the rate of 52.6 miles an hour requires how many hours to run from St. Louis to New York?

*6. A train traveling at the rate of 40 miles an hour requires how many more hours and minutes to run from Omaha to New York than from Kansas City to New York?

II. On the Great Lakes

[With pencil.]

1. Great quantities of iron ore, wheat, and flour are carried through the Great Lakes from Duluth to Buffalo, and great quantities of corn and wheat from Chicago to Buffalo. Point out the routes on a map, and then, with the help of the following table, find the distance to Buffalo (1) from Duluth, (2) from Chicago.

DULUTH TO BUFFALO		CHICAGO TO BUFFALO	
Duluth to the "Soo" Canal	395 mi.	Chicago to the Straits of Mackinaw	324 mi.
The "Soo" to Detroit	332 "	Straits of Mackinaw to Detroit	307 mi.
Detroit to Buffalo	258 "	Detroit to Buffalo	258 "

2. How many hours are required by a steamer traveling 15.5 miles an hour to reach Buffalo from Duluth? From Chicago?

3. The railway distance from Duluth to Buffalo is 1376 miles. Compare with this, by subtraction, the length of the route by water.

4. The following table shows something of the commerce on the Great Lakes for three successive years. Find the missing items:

TRAFFIC ON THE GREAT LAKES

	First Year	Second Year	Third Year	Total	Average per Year
Ships built	174	281	216	?	?
Tons of ore carried	40,715,382	41,407,626	31,118,610	?	?
Bushels of wheat carried	54,983,602	36,707,315	41,868,591	?	?
Barrels of flour carried	123,133	169,911	115,049	?	?

III. The Panama Canal

1. The Panama Canal forms what might be called a water bridge across the Isthmus of Panama. A ship entering from the Atlantic side travels 7.3 mi. and is then raised to the high part of the canal. Through this part, the ship goes 32.06 mi., is lowered, and then goes 10.6 mi. farther. What is the distance through the canal?

2. The Suez Canal is 90 mi. long. What is the difference in the length of these two famous canals?

3. Distances on land are measured by the statute mile; distances at sea, by the nautical mile, which is equivalent to 1.1516 statute miles. To reach Panama by water from New York, it is necessary to travel 1981 nautical miles. This is how many statute miles?

4. From New Orleans to Panama, the route covers 1380 nautical miles. Find the distance in statute miles.

*5. The distance from New York to San Francisco around South America is 13,244 mi.; by way of the Panama Canal, 5309 mi. A warship making 18.75 mi. per hour saves how many hours by taking the canal route? This is a saving of how many days?

15. Problem Test

[With pencil.]

1. The cost of the railway fare for a trip 150 mi. long is how much more with mileage at $.03 than with mileage at $.025?

2. The railway distance from Boston to Chicago is 1022 mi. A train traveling 51.1 mi. per hour takes how long to make the trip?

3. A warship makes the following record in 4 hours: in the first hour, 19.5 mi.; in the second hour, 21.75 mi.; in the third hour, 22.2 mi.; in the fourth hour, 22.9 mi. What is the rate of speed per hour?

4. New Jersey, which has more miles of railway in proportion to its size than any other state in the Union, had, in a recent year, 2146 mi. of railway. Its area is 8224 sq. mi. This made how many miles of railway for each square mile? For each 100 sq. mi.?

CHAPTER III. MAKING USEFUL ARTICLES

16. Review of the Fractional Part

[Without pencil.]

1. Find on a ruler: $\frac{1}{2}$ inch, $\frac{1}{4}$ inch, $\frac{3}{4}$ of an inch, $\frac{1}{8}$ of an inch, $\frac{7}{8}$ of an inch. Explain how each is found.

2. How is $\frac{1}{2}$ of any unit found? How is $\frac{1}{4}$ of any unit found? How is $\frac{3}{4}$ found? $\frac{1}{8}$? $\frac{7}{8}$?

3. What is a fraction?

4. Name and explain the meaning of the terms of the fractions $\frac{3}{4}$, $\frac{5}{8}$, $\frac{11}{16}$.

5. Change $\frac{3}{4}$ to halves; $\frac{6}{8}$ to fourths; $\frac{14}{16}$ to eighths.

6. Explain how to reduce a fraction to its lowest terms.

Reduce to lowest terms:

7. $\frac{8}{9}$, $\frac{2}{14}$, $\frac{8}{12}$, $\frac{5}{10}$, $\frac{16}{18}$.

8. $\frac{8}{16}$, $\frac{12}{16}$, $\frac{5}{20}$, $\frac{7}{14}$, $\frac{30}{40}$.

9. $\frac{10}{30}$, $\frac{4}{6}$, $\frac{44}{55}$, $\frac{12}{18}$, $\frac{25}{50}$.

10. $\frac{14}{21}$, $\frac{21}{28}$, $\frac{20}{25}$, $\frac{15}{30}$, $\frac{30}{45}$.

11. $\frac{6}{18}$, $\frac{18}{24}$, $\frac{30}{36}$, $\frac{36}{48}$, $\frac{66}{72}$.

12. $\frac{16}{24}$, $\frac{16}{32}$, $\frac{40}{48}$, $\frac{64}{72}$, $\frac{80}{96}$.

13. Which of the following lengths are less than an inch? Which are equal to, or are greater than, an inch?

$\frac{3}{4}$ of an inch.	$\frac{8}{8}$ of an inch.	$\frac{5}{16}$ of an inch.
$\frac{4}{4}$ " " "	$\frac{7}{8}$ " " "	$\frac{16}{16}$ " " "
$\frac{5}{4}$ " " "	$\frac{11}{8}$ " " "	$\frac{19}{16}$ " " "

14. What is a proper fraction? An improper fraction?

15. How many inches in $\frac{15}{4}$ inches? In $\frac{9}{8}$ inches? In $\frac{17}{16}$ inches?

16. What is a mixed number? How is an improper fraction changed to a mixed number?

Reduce to whole and to mixed numbers:

17. $\frac{9}{2}$, $\frac{7}{4}$, $\frac{17}{8}$, $\frac{15}{8}$, $\frac{12}{4}$.

18. $\frac{16}{8}$, $\frac{12}{5}$, $\frac{21}{7}$, $\frac{26}{5}$, $\frac{40}{8}$.

19. $\frac{45}{9}$, $\frac{24}{8}$, $\frac{36}{7}$, $\frac{50}{9}$, $\frac{44}{6}$.

20. $\frac{27}{4}$, $\frac{66}{11}$, $\frac{48}{7}$, $\frac{45}{8}$, $\frac{32}{4}$.

21. $\frac{88}{12}$, $\frac{25}{6}$, $\frac{42}{5}$, $\frac{34}{8}$, $\frac{99}{12}$.

22. $\frac{28}{4}$, $\frac{104}{8}$, $\frac{150}{25}$, $\frac{150}{12}$.

23. How many half-inches are there in $3\frac{1}{2}$ inches? How many quarter-inches in $2\frac{3}{4}$ inches? How many eighths of an inch in $1\frac{7}{8}$ inches?

24. How is a mixed number reduced to an improper fraction?

Reduce to improper fractions:

25. $2\frac{1}{2}$, $4\frac{1}{8}$, $9\frac{1}{4}$, $5\frac{3}{4}$, $6\frac{1}{8}$.

26. $1\frac{1}{12}$, $1\frac{3}{16}$, $3\frac{3}{8}$, $7\frac{5}{8}$, $9\frac{3}{11}$.

27. $5\frac{1}{5}$, $8\frac{5}{6}$, $3\frac{5}{7}$, $7\frac{3}{8}$, $9\frac{4}{9}$.

28. $8\frac{5}{6}$, $7\frac{3}{11}$, $4\frac{1}{15}$, $8\frac{7}{9}$, $7\frac{3}{8}$.

29. $2\frac{1}{21}$, $9\frac{5}{7}$, $9\frac{5}{8}$, $7\frac{5}{12}$, $9\frac{5}{6}$.

30. $11\frac{1}{12}$, $3\frac{2}{25}$, $2\frac{1}{30}$, $14\frac{3}{8}$, $2\frac{1}{40}$.

17. Addition and Subtraction of Like Fractions

I

[Use pencil only when needed.]

1. 2 books + 2 books = ? 2 fifths + 2 fifths = ? $\frac{3}{8} + \frac{3}{8} = ?$

Find the sums and differences, reducing answers when necessary:

2. $\frac{3}{8} + \frac{3}{8} = ?$

3. $\frac{5}{16} + \frac{3}{16} + \frac{7}{16} = ?$

4. $\frac{5}{12} + \frac{11}{12} = ?$

5. $\frac{11}{24} + \frac{5}{24} + \frac{3}{24} = ?$

6. $5\frac{3}{8} + 4\frac{5}{8} = ?$

7. $25\frac{3}{8} + 9\frac{3}{8} = ?$

8. $2\frac{3}{7} + 18\frac{5}{7} = ?$

9. $8\frac{3}{8} + 5\frac{3}{8} = ?$

10. $\frac{9}{16} - \frac{5}{16} = ?$

11. $\frac{11}{20} - \frac{3}{20} = ?$

12. $8\frac{5}{6} - 3\frac{1}{6} = ?$

13. $8\frac{1}{12} - 4\frac{5}{12} = ?$

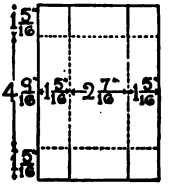
14. In making a football pennant, Margaret cuts $\frac{3}{8}$ of a yard of felt from a piece $1\frac{7}{8}$ yards long. Find the amount left.

15. Find the amount left when, from 12 yards of goods, two pieces are taken, one piece being $4\frac{3}{4}$ yards long, the other, $3\frac{3}{4}$ yards long.

II

[Use pencil only when needed.]

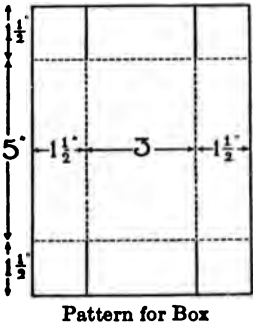
1. The measurements on the patterns pictured here are given in inches.



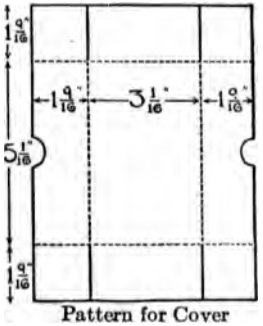
Box Pattern

Find the length of cardboard required for this box. Find its width.

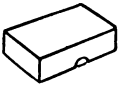
2. The patterns pictured below are for a box and its cover. Find the length and the width of the material required for the box without the cover. For the cover.



Pattern for Box



Pattern for Cover


Box with Cover

*3. That this cover may slide on easily, each dimension was made $\frac{1}{16}$ of an inch longer than the corresponding one in the box. If this were done in making a cover for the box in problem 1, what would be the height of the cover? Its length? Its width?

18. Addition of Unlike Fractions

I

How long a piece of cord is required for two calendars, if one requires $\frac{3}{8}$ of a yard and the other $\frac{5}{8}$ of a yard?

$\frac{3}{8}$ yd. + $\frac{5}{8}$ yd. = ?

$\frac{3}{8} = \frac{16}{24}$

$\frac{5}{8} = \frac{15}{24}$

$\frac{16}{24} + \frac{15}{24} = \frac{31}{24}$, or $1\frac{7}{24}$

Am't required = $1\frac{7}{24}$ yd., or about $1\frac{1}{3}$ yd.

Since only like fractions can be added, $\frac{3}{8}$ and $\frac{5}{8}$ are changed to a common denominator. The smallest number to contain the denominators 3 and 8 is 24; the least common denominator of $\frac{3}{8}$ and $\frac{5}{8}$ is, therefore, 24.

II. Division of a Decimal by Ten or a Multiple of Ten

What is $\frac{1}{10}$ of 752.5 pounds? $\frac{1}{100}$ of the same weight? $\frac{1}{1000}$?

752.5 ÷ 10 = ?	752.5 ÷ 100 = ?	752.5 ÷ 1000 = ?
75.25	7.525	.7525
10)752.5	100)752.5	1000)752.5

[Without pencil.]

1. How many places to the left is the decimal point moved in dividing the number above by 10? By 100? By 1000?
2. Divide by 10: 2.5; 3.75; 425.8; 83.75; 2.425; .625.
3. Divide by 100: 24.5; 275.3; 28.42; 72; 4.5; .5; .25.
4. Divide by 1000: 125.5; 324; 275.34; .8; .75; 34.275.
5. Divide by 2000: 48,658; 6,540; 874; 452; 134; 176; 154.

III. Division by a Decimal[1]

(1)

3	3	3
2 ft.)6 ft.	2 tenths)6 tenths	.2)\.6
2	2	2
4 hr.)8 hr.	4 hundredths)8 hundredths	.04)\.08

In dividing one quantity by another of the same name or denomination, the quotient is an integer when, as in the problems above, the division comes out even.

Find the quotients:

1. .3)\.6 .2)\.4 .3)\.9
2. .02)\.08 .05)\.15
3. .07)\.21 .003)\.009
4. .025)\.075 .022)\.088

[1] A popular but less simple method of explaining the placing of the decimal point in the quotient is called "Clearing the Divisor" — .625 ÷ .25 = ? If there were no decimal place in the divisor (.25), this problem should be solved in the way that all problems are solved when the divisor is a whole number. The question then arises as to the possibility of making the divisor a whole number. Since multiply-

(2)

How many times is .25 miles contained in .625 miles?

.625 ÷ .25 = ?

```
      2.5
.25|.62v5
    50
    125
    125
```

Notice, in dividing .62 by .25, that the terms have the same denominator, and that the quotient is the whole number 2; also, that further division gives the decimal, 5 tenths.

.625 mi. ÷ .25 mi. = 2.5.

.024 ÷ .8 = ?

```
   .03
.8|.0v24
```

.7865 ÷ .005 = ?

```
   157.3
.005|.786v5
```

960 ÷ .32 = ?

```
   3000
.32|960.00v
```

In dividing a number by a decimal, point off with a carat (v) a number of decimal places in the dividend equal to those in the divisor; then place the decimal point in the quotient directly above the carat.

[With pencil.]

First place the decimal point in the quotients and then perform the following divisions:

1. .4|.976
2. .3|8.64
3. .24|.576
4. 3.3|6.963
5. .25|6.775
6. .02|.9768
7. .003|5.7855
8. 2.5|.0075

Divide:

9. .2583 by 2.1.
10. .672 by 3.2.
11. .9951 by .31.
12. 4.686 by 2.2.
13. .6594 by .21.
14. .74904 by .32.
15. 159.375 by 37.5.
16. 36 by .12.
17. 840 by .42.
18. .00492 by .123.

ing both dividend and divisor by the same number does not alter the value of a quotient, it is possible to make the divisor .25 a whole number by multiplying it by 100, provided we also multiply the dividend .625 by 100. .25 × 100 = 25, .625 × 100 = 62.5. .625 ÷ .25 = 62.5 ÷ 25. The rule for this method is: In dividing a number by a decimal, clear the divisor of its decimal by moving the decimal point in both dividend and divisor the necessary places to the right, and then proceed as in the division of a decimal by a whole number.

This method may be used if the teacher prefers it.

of two different heights. The curtain length required for one is $2\frac{7}{8}$ yd.; for the other, $2\frac{1}{3}$ yd. What is the difference in the lengths?

4. A merchant sends to the school a bolt of muslin containing $44\frac{7}{8}$ yards. From this bolt, at first $17\frac{1}{4}$ yards are cut for the necessary number of longer curtains, and then $9\frac{1}{3}$ yards for the shorter curtains. Find the number of yards to be returned to the merchant.

Find the differences:

5. $10\frac{1}{2}$	6. $18\frac{5}{6}$	7. $15\frac{2}{3}$	8. $42\frac{5}{6}$	9. $45\frac{3}{4}$	10. $60\frac{3}{8}$
$4\frac{1}{4}$	$7\frac{1}{3}$	$8\frac{1}{4}$	$12\frac{1}{3}$	$18\frac{1}{10}$	$18\frac{1}{2}$
11. $16\frac{7}{8}$	12. $24\frac{2}{3}$	13. $28\frac{1}{2}$	14. $30\frac{5}{8}$	15. $12\frac{1}{3}$	16. $40\frac{1}{3}$
$14\frac{1}{6}$	$9\frac{1}{3}$	$14\frac{1}{7}$	$14\frac{1}{3}$	$8\frac{8}{10}$	$12\frac{1}{10}$

II

If, from $8\frac{1}{4}$ yards of goods, $5\frac{2}{3}$ yards are cut, how many yards will there be in the shorter piece?

$8\frac{1}{4}$ yd. $- 5\frac{2}{3}$ yd. $= ?$

The l.c.d. of the fractions $\frac{1}{4}$ and $\frac{2}{3}$ is 12. $8\frac{1}{4} = 8\frac{3}{12}$. $5\frac{2}{3} = 5\frac{8}{12}$. Since $\frac{8}{12}$ cannot be subtracted from $\frac{3}{12}$, 1 is taken from the integer in the minuend, called $\frac{12}{12}$, and added to the fraction.

FORM IN FULL

$8\frac{1}{4} = 8\frac{3}{12}$
$5\frac{2}{3} = 5\frac{8}{12}$
$8\frac{3}{12} = 7\frac{12}{12} + \frac{3}{12}$, or $7\frac{15}{12}$
$7\frac{15}{12} - 5\frac{8}{12} = 2\frac{7}{12}$
$8\frac{1}{4}$ yd. $- 5\frac{2}{3}$ yd. $= 2\frac{7}{12}$ yd.

SHORT FORM

$8\frac{1}{4}$	3
$5\frac{2}{3}$	8
Ans. $2\frac{7}{12}$	

[With pencil.]

1. Subtract: $4\frac{3}{4}$ from $7\frac{1}{8}$; $5\frac{2}{3}$ from $12\frac{1}{2}$; $24\frac{1}{2}$ from $30\frac{1}{6}$.

2. One sheet of paper is $8\frac{1}{4}$ inches wide; another is $12\frac{3}{16}$ inches wide. Find the difference in their widths.

3. John made two window boxes. One was $36\frac{1}{2}$ inches long; the *other,* $27\frac{3}{4}$ inches long. How much longer was one than the other?

4. Margaret and Elizabeth both made cooking aprons. Margaret used $2\frac{1}{4}$ yd. of muslin; Elizabeth, $1\frac{7}{8}$ yd. Find the difference in the amounts used.

Subtract:

5. $8\frac{1}{4}$	6. $25\frac{1}{3}$	7. $15\frac{1}{6}$	8. 42	9. 18	10. 30
$2\frac{1}{2}$	$14\frac{1}{2}$	$6\frac{1}{3}$	$21\frac{1}{2}$	$7\frac{2}{3}$	$12\frac{5}{16}$
11. $14\frac{2}{7}$	12. $40\frac{1}{4}$	13. $21\frac{1}{2}$	14. $32\frac{1}{8}$	15. $84\frac{2}{3}$	16. $108\frac{2}{7}$
$8\frac{1}{2}$	$28\frac{2}{3}$	$19\frac{2}{3}$	$17\frac{3}{8}$	$41\frac{3}{4}$	$99\frac{5}{6}$

20. Review and Practice

[Without pencil.]

Use these numbers first for addition and then for subtraction:

1. $3\frac{1}{2}$	2. $5\frac{3}{4}$	3. $6\frac{3}{4}$	4. $7\frac{5}{8}$	5. $12\frac{2}{3}$	6. $14\frac{4}{5}$	7. $6\frac{5}{12}$
$2\frac{1}{2}$	$5\frac{1}{4}$	$2\frac{3}{4}$	$3\frac{1}{8}$	$5\frac{1}{3}$	$3\frac{1}{5}$	$2\frac{1}{12}$
8. $4\frac{1}{2}$	9. $6\frac{7}{8}$	10. $5\frac{5}{6}$	11. $5\frac{5}{12}$	12. $6\frac{5}{16}$	13. $7\frac{1}{2}$	14. $11\frac{1}{3}$
$2\frac{1}{4}$	$3\frac{1}{2}$	$1\frac{1}{3}$	$2\frac{1}{3}$	$3\frac{1}{4}$	$2\frac{1}{3}$	$3\frac{1}{4}$

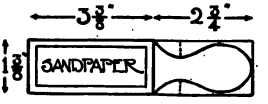
[With pencil.]

15. $12\frac{3}{4}$	16. $14\frac{3}{5}$	17. $16\frac{1}{3}$	18. $14\frac{1}{6}$	19. $28\frac{3}{4}$	20. $18\frac{1}{4}$	21. $30\frac{1}{3}$
$6\frac{2}{3}$	$8\frac{1}{4}$	$5\frac{3}{4}$	$12\frac{1}{2}$	$15\frac{5}{8}$	$3\frac{5}{16}$	$7\frac{3}{8}$

21. Jackknife Construction

[Use pencil only when needed.]

1. This pencil sharpener is made of a thin strip of wood upon which is glued a rectangle of sandpaper. What is the length of the strip of wood required?



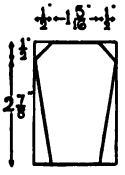
Pencil Sharpener

2. What is the width of the handle in its narrowest part, if the two dotted lines are each $\frac{7}{16}$ of an inch long?

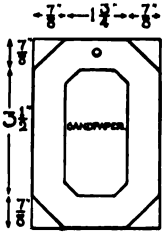
3. What is the width of the handle in its widest part if, in making the pencil sharpener, $\frac{1}{8}$ of an inch is whittled off the width of the block on each side?

4. The three even margins of wood showing beyond the sandpaper are each $\frac{1}{4}$ of an inch wide. What is the length and width of the rectangle of sandpaper used?

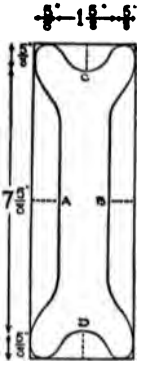
5. Find the length and width of the block of wood required for each of the following articles:



Window Husher



Match Scratcher



String Winder

6. The margins beyond the sandpaper in the match scratcher are each $\frac{7}{8}$ of an inch wide. What is the greatest length of the sandpaper? What is its greatest width?

7. A piece of wood $\frac{3}{4}$ of an inch thick is used for the string winder. This is planed down $\frac{3}{10}$ of an inch on one side and $\frac{1}{8}$ of an inch on the other. How thick is it then?

*8. The dotted lines on the string winder, that show how much wood should be whittled off each side, are each $\frac{3}{4}$ of an inch long. How wide is the string winder from A to B?

*9. The dotted lines at the ends of the string winder are each $\frac{7}{8}$ of an inch long. What is the distance between the two points C and D?

*10. Make and solve a problem of your own on the measurements used in making some article.

11. Subtract the sum of $4\frac{1}{2}$ in. and $12\frac{7}{8}$ in. from $18\frac{1}{4}$ in.

12. Find the difference between $2\frac{3}{8}$ in. + $8\frac{3}{4}$ in. and $1\frac{1}{2}$ in. + $4\frac{5}{8}$ in.

22. Multiplication of Fractions

I

(1) What part of a yard is $\frac{1}{2}$ of $\frac{3}{4}$ of a yard?

$\frac{1}{2}$ of $\frac{3}{4}$ yd. = ?

$\frac{1}{2}$ of $\frac{3}{4} = \frac{1 \times 3}{2 \times 4} = \frac{3}{8}$. $\frac{1}{2}$ of $\frac{3}{4}$ yd. = $\frac{3}{8}$ yd.

(2) How many yards of cloth in $\frac{2}{3}$ of 4 yards? (3) In 3 times $\frac{7}{8}$ of a yard?

(2)	(3)
$\frac{2}{3} \times 4$ yd. = ?	$3 \times \frac{7}{8}$ yd. = ?
$\frac{2}{3} \times 4 = \frac{8}{3}$, or $2\frac{2}{3}$.	$3 \times \frac{7}{8} = \frac{21}{8}$, or $2\frac{5}{8}$.
$\frac{2}{3}$ of 4 yd. = $2\frac{2}{3}$ yd.	$3 \times \frac{7}{8}$ yd. = $2\frac{5}{8}$ yd.

[Without pencil.]

1. Explain how the answer in each solution above was found.

Multiply:

2. $\frac{2}{5}$ by $\frac{1}{5}$.	5. $\frac{3}{4}$ by 5.	8. 5 by $\frac{2}{3}$.	11. $\frac{4}{7}$ by $\frac{2}{5}$.
3. $\frac{5}{6}$ by $\frac{1}{7}$.	6. $\frac{7}{8}$ by 3.	9. 8 by $\frac{4}{5}$.	12. $\frac{2}{3}$ by 7.
4. $\frac{3}{8}$ by $\frac{3}{4}$.	7. $\frac{5}{6}$ by 7.	10. 9 by $\frac{3}{4}$.	13. 10 by $\frac{2}{3}$.

II

At 10¢ a yard, what is the cost of $\frac{3}{4}$ of a yard of lining?

$\frac{3}{4}$ of 10¢ = ?

$\frac{3}{\cancel{4}_{2}} \times \cancel{10}^{5} = \frac{15}{2}$, or $7\frac{1}{2}$. $\frac{3}{4}$ of 10¢ = $7\frac{1}{2}$¢.

1. In solving this problem, the common factor 2 was canceled from the number 10 and from the number 4. Why is it necessary in cancellation to strike out the same factor from both the numerator and the denominator?

Find the products, canceling where possible: [With pencil.]

2. $28 \times \frac{3}{4}$.
3. $75 \times \frac{2}{5}$.
4. $72 \times \frac{3}{8}$.
5. $125 \times \frac{1}{25}$.
6. $90 \times \frac{4}{15}$.
7. $\frac{3}{4} \times 408$.
8. $\frac{3}{8} \times 240$.
9. $\frac{1}{12} \times 288$.
10. $\frac{7}{8}$ of 640.
11. $\frac{5}{6}$ of 144.
12. $\frac{3}{8} \times \frac{9}{16}$.
13. $\frac{5}{8} \times \frac{34}{35}$.
14. $\frac{3}{4} \times \frac{8}{15}$.
15. $\frac{5}{12} \times \frac{8}{11}$.
16. $\frac{5}{6} \times \frac{13}{25}$.
17. $\frac{1}{2} \times \frac{3}{8} \times 240$.
18. $14 \times \frac{1}{3} \times \frac{3}{4}$.
19. $18 \times \frac{3}{8} \times \frac{1}{12}$.
20. $\frac{3}{4} \times \frac{1}{2} \times 320$.
21. $\frac{3}{5} \times \frac{5}{8} \times 400$.

23. The Mixed Number in Multiplication

I. Review

At $12\frac{1}{2}$¢ a yard, what is the price of 6 yards of braid? Of $1\frac{1}{4}$ yards?

$12\frac{1}{2}¢ \times 6 = ?$

$$\begin{array}{r} 12\frac{1}{2} \\ 6 \\ \hline 3\ (6 \times \frac{1}{2}) \\ 72\ (6 \times 12) \\ \hline 75 \end{array}$$

$12\frac{1}{2}¢ \times 6 = 75¢$.

$12\frac{1}{2}¢ \times 1\frac{1}{4} = ?$

$12\frac{1}{2} = \frac{25}{2}$.

$1\frac{1}{4} = \frac{5}{4}$.

$\frac{25}{2} \times \frac{5}{4} = \frac{125}{8}$, or $15\frac{5}{8}$.

$12\frac{1}{2}¢ \times 1\frac{1}{4} = 15\frac{5}{8}¢$.

1. In the multiplication of fractions, where mixed numbers occur, what change may be made in the mixed numbers if it is desired?

2. Is it convenient to make a change in the mixed number in multiplying 3 by $2\frac{1}{3}$? In multiplying $12\frac{1}{2}$ by 2? In multiplying $4\frac{1}{2}$ by $3\frac{1}{3}$?

[With pencil.]

Multiply, choosing for each problem the most convenient method:

3. 16 by $2\frac{1}{4}$.
4. 72 by $3\frac{1}{2}$.
5. 64 by $2\frac{3}{8}$.
6. 25 by $4\frac{2}{3}$.
7. 32 by $21\frac{1}{2}$.
8. $37\frac{1}{2}$ by 2.
9. $18\frac{2}{3}$ by 6.
10. $24\frac{2}{3}$ by 12.
11. $18\frac{1}{8}$ by 6.
12. $27\frac{3}{7}$ by 15.
13. $3\frac{1}{3}$ by $\frac{3}{8}$.
14. $4\frac{1}{2}$ by $\frac{4}{9}$.
15. $12\frac{1}{2}$ by $\frac{3}{8}$.
16. $6\frac{1}{4}$ by $\frac{4}{5}$.
17. $7\frac{1}{2}$ by $\frac{3}{4}$.
18. $3\frac{1}{3}$ by $4\frac{1}{4}$.
19. $5\frac{1}{7}$ by $2\frac{1}{10}$.
20. $3\frac{3}{4}$ by $2\frac{1}{8}$.
21. $7\frac{1}{2}$ by $16\frac{2}{3}$.
22. $18\frac{1}{2}$ by $7\frac{3}{4}$.

23. For a school festival, the boys in a class dressed as Indians, and the girls as Puritans. By buying the cambric for their costumes in quantity, the cost per yard was 16¢. Each Indian costume required $3\frac{1}{2}$ yards of tan cambric and $1\frac{1}{4}$ yards of green. How much did the material for each costume cost?

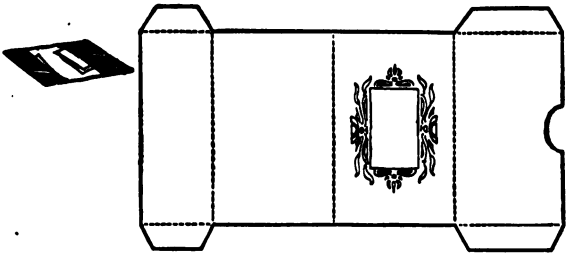
24. How many yards of tan cambric was it necessary to order for 20 suits? How many yards of green were needed?

25. The Puritan costumes required $7\frac{1}{2}$ yards of gray cambric and 1 yard of white. How much did each Puritan costume cost?

26. Find the amount of gray cambric left in a bolt of 64 yards after cutting from it material for 8 Puritan costumes.

*27. Find the total cost of 20 Indian and 24 Puritan costumes.

II. Drawing Patterns to a Scale



Card Case and Pattern

[Use pencil for drawings only.]

1. The pattern pictured here is for a card case. For each fourth of an inch in the drawing, the pattern is to be made 1 inch long; that is, the pattern here is drawn to a scale of $\frac{1}{4}$ of an inch to an inch. With the help of a ruler, find how long the real pattern should be drawn. Find the width of the narrowest part. The width of the widest part.

2. If you were to represent a line 12 inches long on a scale of $\frac{1}{2}$ inch to an inch, how long a line would you draw?

Name the length of line required to represent:

3. A line 8 inches long, drawn to a scale of $\frac{1}{4}''$ to an inch.

4. A line 24 inches long, drawn to a scale of $\frac{3}{8}''$ to an inch.

5. A line 32 feet long, drawn to a scale of $\frac{1}{16}''$ to a foot.

6. A line 48 feet long, drawn to a scale of $\frac{3}{16}''$ to a foot.

7. A line $12\frac{1}{2}$ feet long, drawn to a scale of $\frac{1}{2}''$ to a foot.

Draw the pattern:

8. Of an 8-inch square, to a scale of $\frac{1}{4}''$ to an inch.

9. Of a square $2\frac{1}{2}$ inches on a side, to a scale of $\frac{1}{2}''$ to an inch.

10. Of a rectangle 4 inches by 6 inches, to a scale of $\frac{1}{2}''$ to an inch.

11. Of a rectangle 8 inches by 12 inches, to a scale of $\frac{3}{8}''$ to an inch.

12. Of a rectangle $2\frac{1}{2}$ feet by $6\frac{1}{2}$ feet, to a scale of $\frac{1}{2}''$ to a foot.

13. Of a rectangle 50 feet by 80 feet, to a scale of $\frac{3}{8}$ of an inch to 10 feet.

*14. Draw to any convenient scale an original pattern for a box, a portfolio, or an envelope.

III. Exercises for Skill

[Use pencil only when needed.]

Solve each problem, using the most convenient method:

1. $120 \times \frac{2}{3}$.
2. $115 \times \frac{3}{4}$.
3. $80 \times 1\frac{1}{4}$.
4. $117 \times 2\frac{3}{5}$.
5. $124 \times 16\frac{2}{3}$.
6. $150 \times 22\frac{3}{4}$.
7. $\frac{3}{4} \times 160$.
8. $\frac{2}{5} \times 64$.
9. $24\frac{1}{2} \times 8$.
10. $15\frac{1}{3} \times 10$.
11. $112\frac{1}{2} \times 24$.
12. $64\frac{1}{3} \times 15$.
13. $\frac{5}{8} \times \frac{4}{5}$.
14. $\frac{5}{16} \times \frac{3}{8}$.
15. $1\frac{1}{2} \times \frac{2}{6}$.
16. $9\frac{2}{3} \times \frac{3}{8}$.
17. $33\frac{1}{3} \times 1\frac{2}{3}$.
18. $16\frac{2}{3} \times 1\frac{3}{4}$.
19. $45 \times \frac{7}{8}$.
20. $112 \times \frac{3}{8}$.
21. $18\frac{3}{4} \times 16$.
22. $22\frac{1}{2} \times 1\frac{2}{3}$.
23. $83\frac{1}{3} \times 37\frac{1}{2}$.
24. $24\frac{3}{4} \times 14\frac{1}{4}$.

24. Division of Fractions

I. Review

How many pieces of cord each $\frac{3}{4}$ of a yard long can be cut from 12 yards?

$12 \div \frac{3}{4} = ?$

$1 \div \frac{3}{4} = \frac{4}{3}$. $12 \div \frac{3}{4} = 12 \times \frac{4}{3}$, or 16.

1. What is meant by the inversion of the terms of a fraction? In the division of fractions, which fraction is inverted?

How many badges $3\frac{1}{2}$ in. long can be cut from $17\frac{1}{2}$ in. of ribbon?

$17\frac{1}{2}$ in. $\div 3\frac{1}{2}$ in. $= ?$

$17\frac{1}{2} = \frac{35}{2}$. $3\frac{1}{2} = \frac{7}{2}$. $\frac{35}{2} \div \frac{7}{2} = \frac{35}{2} \times \frac{2}{7}$, or 5.

The no. of badges = 5.

2. When a mixed number occurs in division, what reduction is it convenient to make?

3. Find another way of dividing $\frac{35}{2}$ by $\frac{5}{2}$ in the problem above, other than by inverting the terms of the divisor.

[Use pencil only when needed.]

4. Divide: 5 by $\frac{1}{2}$; 12 by $\frac{2}{3}$; $\frac{5}{8}$ by $\frac{5}{16}$; $\frac{3}{4}$ by 2; 15 by $2\frac{1}{2}$; $10\frac{1}{2}$ by $1\frac{1}{2}$.

5. Find how many needle books, each requiring $\frac{3}{8}$ of a yard of ribbon, can be cut from 3 yards of ribbon.

6. Sash curtains, each $\frac{7}{8}$ of a yard long, are to be made from 14 yards of muslin. How many such curtains can be made?

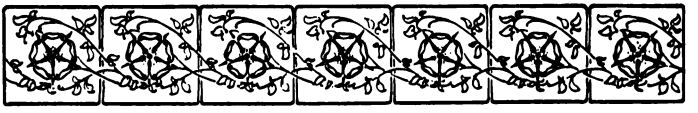
7. A remnant containing $7\frac{1}{2}$ yards of cotton cloth is bought for 60¢. This price is how much less a yard than the regular price of $12\frac{1}{2}$¢ a yard?

Divide:

8. 7 by $\frac{1}{2}$.
9. 4 by $\frac{2}{3}$.
10. 8 by $\frac{3}{4}$.
11. $\frac{4}{5}$ by 2.
12. 20 by $2\frac{1}{2}$.
13. 10 by $3\frac{1}{3}$.
14. 12 by $1\frac{1}{2}$.
15. $7\frac{1}{2}$ by 5.

16. $\frac{3}{4}$ by $\frac{3}{8}$.
17. $\frac{1}{2}$ by $\frac{1}{4}$.
18. $\frac{5}{6}$ by $\frac{2}{3}$.
19. $\frac{7}{8}$ by $\frac{5}{16}$.
20. $3\frac{1}{2}$ by $\frac{3}{4}$.
21. $12\frac{1}{2}$ by $6\frac{1}{4}$.
22. $7\frac{1}{3}$ by $2\frac{1}{6}$.
23. $14\frac{2}{3}$ by $3\frac{2}{3}$.

II. Placing Designs



[Use pencil only when needed.]

1. How many times can a design $\frac{1}{2}$ inch long be repeated in a border $3\frac{1}{2}$ inches long, if, as in the border above, the design and the border are of the same width? How many times can the design be repeated if the border is made $7\frac{1}{2}$ inches long?

2. An oak leaf design $2\frac{1}{2}$ inches long is to be used in making a glove box. The space on the top of the box to be decorated is of the same width as the design and $12\frac{1}{2}$ inches long. How many times can the design be repeated?

3. Find the number of times that a butterfly design $2\frac{1}{4}$ inches square can be repeated across the end of a stand cloth in a space $2\frac{1}{4}$ inches wide and 18 inches long.

*4. Find the number of times that a design $3\frac{1}{8}$ inches square can be repeated in a border $3\frac{1}{8}$ inches wide and $17\frac{1}{2}$ inches long, if spaces $\frac{3}{8}$ of an inch wide are left undecorated between the designs.

*5. Draw an original design $1\frac{1}{4}$ inches square. Find the number of times it can be repeated in borders of different lengths.

III. Exercises for Skill

Divide:

[Use pencil only when needed.]

1. 8 by $\frac{2}{3}$.
2. 12 by $\frac{1}{4}$.
3. 20 by $\frac{4}{5}$.
4. 18 by $\frac{5}{8}$.
5. 50 by $\frac{8}{16}$.
6. 72 by $\frac{5}{11}$.
7. 10 by $2\frac{1}{2}$.
8. 20 by $3\frac{1}{3}$.
9. 15 by $1\frac{2}{3}$.
10. 25 by $6\frac{1}{4}$
11. 27 by $2\frac{2}{3}$
12. 42 by $1\frac{2}{3}$

13. $\frac{5}{16}$ by $\frac{3}{8}$.
14. $\frac{2}{3}$ by $\frac{5}{6}$.
15. $\frac{4}{5}$ by $\frac{2}{3}$.
16. $4\frac{1}{2}$ by $\frac{1}{4}$.
17. $12\frac{1}{2}$ by $\frac{3}{4}$.
18. $5\frac{1}{5}$ by $\frac{9}{10}$.
19. $16\frac{1}{4}$ by $\frac{3}{8}$.
20. $2\frac{1}{5}$ by $1\frac{1}{10}$
21. $3\frac{1}{3}$ by $2\frac{1}{9}$.
22. $4\frac{1}{4}$ by $1\frac{3}{8}$.
23. $8\frac{1}{2}$ by $3\frac{1}{3}$.
24. $5\frac{3}{4}$ by $1\frac{5}{16}$.

25. Simple and Complex Fractions

The division of two numbers is often indicated by writing them as fractions. For example, $2 \div 5$ is written as $\frac{2}{5}$, and $4 \div 7$ as $\frac{4}{7}$. In the same way, $\frac{2}{3} \div \frac{1}{4}$ may be written as $\frac{\frac{2}{3}}{\frac{1}{4}}$, and $\frac{5}{8} \div 4$ as $\frac{\frac{5}{8}}{4}$.

$\frac{\frac{2}{3}}{\frac{1}{4}}$ is read $\frac{2}{3} \div \frac{1}{4}$, and $\frac{\frac{5}{8}}{4}$ is read $\frac{5}{8} \div 4$.

A fraction with an integer for both numerator and denominator is called a **simple fraction.**

$\frac{3}{4}$, $\frac{7}{8}$, $\frac{13}{25}$ are simple fractions.

A fraction with a fraction or a mixed number in either numerator or denominator is called a **complex fraction.**

$\frac{\frac{3}{4}}{2}$, $\frac{4}{\frac{2}{3}}$, $\frac{\frac{2}{3}}{\frac{3}{4}}$, and $\frac{2\frac{1}{2}}{\frac{7}{8}}$ are complex fractions.

Classify each of the following fractions as simple or complex, and tell what is meant by each:

1. $\frac{4}{5}$, $2\frac{3}{8}$, $\frac{6}{\frac{1}{2}}$.
2. $\frac{4\frac{2}{3}}{2}$, $\frac{3}{4}$, $\frac{\frac{1}{2}}{\frac{1}{4}}$.
3. $\frac{\frac{3}{5}}{\frac{3}{4}}$, $\frac{4\frac{1}{2}}{5}$, $\frac{5}{16}$.
4. $\frac{8}{\frac{1}{4}}$, $\frac{\frac{2}{3}}{\frac{1}{6}}$, $\frac{\frac{3}{8}}{\frac{1}{4}}$.
5. $\frac{3\frac{1}{3}}{\frac{7}{8}}$, $\frac{2\frac{1}{5}}{1\frac{7}{20}}$, $\frac{15\frac{1}{5}}{\frac{8}{15}}$.
6. $\frac{12}{2\frac{1}{4}}$, $\frac{24}{25}$, $\frac{2\frac{1}{3}}{3\frac{1}{9}}$.
7. $\frac{\frac{3}{4}}{\frac{5}{16}}$, $\frac{\frac{5}{8}}{2}$, $\frac{27}{4}$.
8. $\frac{8\frac{1}{2}}{\frac{5}{8}}$, $\frac{5}{18}$, $\frac{25}{3\frac{1}{8}}$.
9. $\frac{17\frac{1}{2}}{5}$, $\frac{24}{\frac{11}{16}}$, $\frac{16\frac{2}{3}}{4\frac{1}{6}}$.

[With pencil.]

10. Perform the divisions indicated by each complex fraction above.

11. Express as complex fractions: $\frac{3}{16} \div \frac{1}{3}$; $9 \div \frac{2}{3}$; $37\frac{1}{4} \div 6$.

26. Test and Graded Practice

With the help of these exercises find out and overcome your difficulties with common fractions. If you fail to get the correct answer to a problem in the test, practice solving the problems in the set below having the same letter.

Test No. 11. [Use pencil only when needed.]

A. $4\frac{2}{3} + 5\frac{5}{6} + 6\frac{3}{8} = ?$

B. $9\frac{7}{8} - 3\frac{2}{3} = ?$

C. $12\frac{1}{5} - 9\frac{3}{4} = ?$

D. $25 \times \frac{2}{3} = ?$

E. $13\frac{1}{3} \times 8 = ?$

F. $48 \times 2\frac{3}{4} = ?$

G. $\frac{5}{6} \times \frac{3}{4} = ?$

H. $3\frac{2}{3} \times 4\frac{4}{5} = ?$

I. $16 \div \frac{4}{5} = ?$

J. $\frac{5}{6} \div \frac{2}{3} = ?$

K. $3\frac{1}{3} \div 2\frac{1}{4} = ?$

L. $\dfrac{2\frac{1}{4}}{3} = ?$

Practice [1]

Do work indicated: [Use pencil only when needed.]

A.	D.	G.	J.
1. $16\frac{7}{8} + 14\frac{5}{8}$.	13. $\frac{3}{4} \times 28$.	25. $\frac{2}{3} \times \frac{3}{8}$.	37. $\frac{3}{4} \div \frac{1}{2}$.
2. $11\frac{4}{9} + 2\frac{1}{3}$.	14. $\frac{2}{3} \times 35$.	26. $\frac{4}{11} \times \frac{5}{12}$.	38. $\frac{5}{16} \div \frac{5}{8}$.
3. $4\frac{1}{12} + 3\frac{1}{4} + 5\frac{2}{3}$.	15. $42 \times \frac{6}{7}$.	27. $\frac{7}{8} \times \frac{5}{9}$.	39. $\frac{11}{12} \div \frac{3}{8}$.
4. $7\frac{1}{2} + 3\frac{2}{5} + 1\frac{3}{4}$.	16. $75 \times \frac{5}{8}$.	28. $\frac{8}{9} \times \frac{4}{7}$.	40. $\frac{3}{4} \div \frac{2}{3}$.

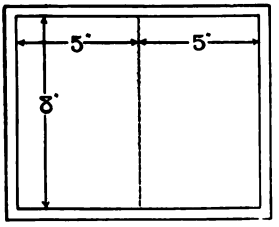
B.	E.	H.	K.
5. $11\frac{5}{16} - 4\frac{1}{16}$.	17. $12\frac{1}{2} \times 2$.	29. $2\frac{1}{2} \times \frac{4}{5}$.	41. $2\frac{1}{2} \div \frac{1}{4}$.
6. $28\frac{3}{4} - 14$.	18. $20\frac{2}{3} \times 9$.	30. $\frac{7}{8} \times 4\frac{4}{5}$.	42. $\frac{5}{16} \div 2\frac{1}{2}$.
7. $21\frac{3}{4} - 16\frac{2}{3}$.	19. $31\frac{4}{5} \times 7$.	31. $3\frac{3}{7} \times 2\frac{1}{3}$.	43. $2\frac{5}{8} \div 1\frac{3}{4}$.
8. $29\frac{11}{12} - 14\frac{5}{8}$.	20. $112\frac{7}{8} \times 3$.	32. $3\frac{1}{5} \times 1\frac{2}{3}$.	44. $10\frac{2}{3} \div 1\frac{1}{3}$.

C.	F.	I.	L.	
9. $14 - 2\frac{7}{8}$.	21. $42 \times 2\frac{1}{2}$.	33. $8 \div \frac{1}{2}$.	45. $\dfrac{\frac{7}{8}}{2}$.	47. $\dfrac{3\frac{3}{8}}{8}$
10. $16\frac{1}{5} - 4\frac{4}{5}$.	22. $24 \times 2\frac{1}{4}$.	34. $25 \div \frac{5}{8}$.	46. $\dfrac{4\frac{1}{2}}{3}$	48. $\dfrac{7\frac{1}{3}}{4}$
11. $12\frac{1}{9} - 6\frac{2}{3}$.	23. $16 \times 3\frac{3}{4}$.	35. $72 \div \frac{2}{3}$.		
12. $9\frac{1}{4} - 3\frac{5}{8}$.	24. $25 \times 6\frac{2}{3}$.	36. $64 \div \frac{3}{8}$.		

[1] For simpler and more detailed practice, see pages 58, 73, and 114.

27. Desk Conveniences

[Use pencil only when needed.]



Notebook

1. Sheets of paper 8″ by 10″ are to be folded and bound as a notebook in a cover made to extend $\frac{3}{8}$ of an inch in each direction beyond the inside sheets. What should be the dimensions of the cover?

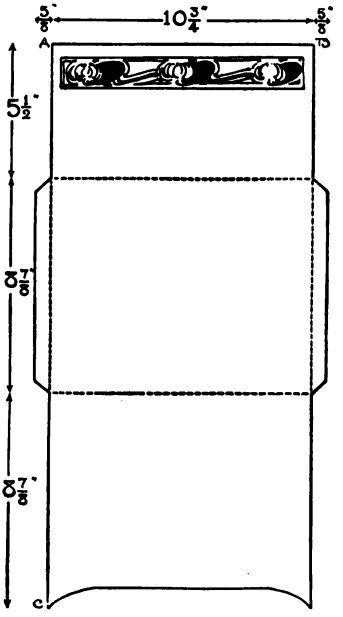
2. Give the dimensions of the cover for a notebook made as pictured in the cut, but of paper $7\frac{1}{2}''$ by $11\frac{1}{2}''$ folded once, the covering extending in each direction $\frac{1}{4}$ of an inch beyond the inside sheets.

3. Draw to a scale of $\frac{1}{4}''$ to $1''$, the cover described in problem 2.

4. The pattern for the envelope pictured here is drawn on heavy paper, cut on the heavy lines, and folded on the dotted lines. How long a piece of paper is required for it? How wide a piece?

5. If the pattern were drawn to a scale of $\frac{1}{4}''$ to $1''$, how long a line would be required to represent the distance from A to B? From A to C?

6. A border 10 inches long and $1\frac{1}{4}$ inches wide is to be drawn on the flap of the envelope pictured here. How many times can a design $1\frac{1}{4}$ inches square be repeated in the space to be decorated?



Envelope or Case for Papers

of two different heights. The curtain length required for one is $2\frac{7}{8}$ yd.; for the other, $2\frac{1}{3}$ yd. What is the difference in the lengths?

4. A merchant sends to the school a bolt of muslin containing $44\frac{7}{8}$ yards. From this bolt, at first $17\frac{1}{4}$ yards are cut for the necessary number of longer curtains, and then $9\frac{1}{3}$ yards for the shorter curtains. Find the number of yards to be returned to the merchant.

Find the differences:

5. $10\frac{1}{2}$	6. $18\frac{5}{8}$	7. $15\frac{3}{8}$	8. $42\frac{5}{8}$	9. $45\frac{3}{4}$	10. $60\frac{3}{8}$
$4\frac{1}{4}$	$7\frac{1}{3}$	$8\frac{1}{4}$	$12\frac{1}{6}$	$18\frac{1}{10}$	$18\frac{1}{2}$
11. $16\frac{7}{8}$	12. $24\frac{3}{8}$	13. $28\frac{1}{2}$	14. $30\frac{5}{8}$	15. $12\frac{1}{3}$	16. $40\frac{1}{8}$
$14\frac{1}{6}$	$9\frac{1}{3}$	$14\frac{1}{7}$	$14\frac{1}{3}$	$8\frac{3}{10}$	$12\frac{1}{10}$

II

If, from $8\frac{1}{4}$ yards of goods, $5\frac{2}{3}$ yards are cut, how many yards will there be in the shorter piece?

$8\frac{1}{4}$ yd. $- 5\frac{2}{3}$ yd. $= ?$

The l.c.d. of the fractions $\frac{1}{4}$ and $\frac{2}{3}$ is 12. $8\frac{1}{4} = 8\frac{3}{12}$. $5\frac{2}{3} = 5\frac{8}{12}$. Since $\frac{8}{12}$ cannot be subtracted from $\frac{3}{12}$, 1 is taken from the integer in the minuend, called $\frac{12}{12}$, and added to the fraction.

FORM IN FULL

$8\frac{1}{4} = 8\frac{3}{12}$
$5\frac{2}{3} = 5\frac{8}{12}$
$8\frac{3}{12} = 7\frac{12}{12} + \frac{3}{12}$, or $7\frac{15}{12}$
$7\frac{15}{12} - 5\frac{8}{12} = 2\frac{7}{12}$
$8\frac{1}{4}$ yd. $- 5\frac{2}{3}$ yd. $= 2\frac{7}{12}$ yd.

SHORT FORM

$8\frac{1}{4}$ | 3
$5\frac{2}{3}$ | 8
$\frac{7}{12}$

Ans. $2\frac{7}{12}$

[With pencil.]

1. Subtract: $4\frac{3}{4}$ from $7\frac{1}{8}$; $5\frac{2}{3}$ from $12\frac{1}{2}$; $24\frac{1}{2}$ from $30\frac{1}{6}$.

2. One sheet of paper is $8\frac{1}{4}$ inches wide; another is $12\frac{3}{10}$ inches wide. Find the difference in their widths.

3. John made two window boxes. One was $36\frac{1}{2}$ inches long; the *other, $27\frac{3}{4}$* inches long. How much longer was one than the other?

4. Margaret and Elizabeth both made cooking aprons. Margaret used $2\frac{1}{4}$ yd. of muslin; Elizabeth, $1\frac{7}{8}$ yd. Find the difference in the amounts used.

Subtract:

5. $8\frac{1}{4}$	6. $25\frac{1}{3}$	7. $15\frac{1}{6}$	8. 42	9. 18	10. 30
$2\frac{1}{2}$	$14\frac{1}{2}$	$6\frac{1}{3}$	$21\frac{1}{2}$	$7\frac{2}{3}$	$12\frac{5}{16}$
11. $14\frac{3}{7}$	12. $40\frac{1}{4}$	13. $21\frac{1}{2}$	14. $32\frac{1}{8}$	15. $84\frac{2}{3}$	16. $108\frac{2}{7}$
$8\frac{1}{2}$	$28\frac{2}{3}$	$19\frac{2}{3}$	$17\frac{3}{8}$	$41\frac{3}{4}$	$99\frac{5}{6}$

20. Review and Practice

[Without pencil.]

Use these numbers first for addition and then for subtraction:

1. $3\frac{1}{2}$	2. $5\frac{3}{4}$	3. $6\frac{3}{4}$	4. $7\frac{5}{8}$	5. $12\frac{2}{3}$	6. $14\frac{4}{5}$	7. $6\frac{5}{12}$
$2\frac{1}{2}$	$5\frac{1}{4}$	$2\frac{3}{4}$	$3\frac{1}{8}$	$5\frac{1}{3}$	$3\frac{1}{5}$	$2\frac{1}{12}$
8. $4\frac{1}{2}$	9. $6\frac{7}{8}$	10. $5\frac{5}{6}$	11. $5\frac{5}{12}$	12. $6\frac{5}{16}$	13. $7\frac{1}{2}$	14. $11\frac{1}{3}$
$2\frac{1}{4}$	$3\frac{1}{2}$	$1\frac{1}{3}$	$2\frac{1}{3}$	$3\frac{1}{4}$	$2\frac{1}{3}$	$3\frac{1}{4}$

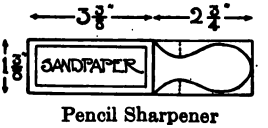
[With pencil.]

15. $12\frac{3}{4}$	16. $14\frac{3}{8}$	17. $16\frac{1}{3}$	18. $14\frac{1}{6}$	19. $28\frac{3}{4}$	20. $18\frac{1}{4}$	21. $30\frac{1}{3}$
$6\frac{2}{3}$	$8\frac{1}{4}$	$5\frac{3}{4}$	$12\frac{1}{2}$	$15\frac{5}{8}$	$3\frac{5}{16}$	$7\frac{3}{8}$

21. Jackknife Construction

[Use pencil only when needed.]

1. This pencil sharpener is made of a thin strip of wood upon which is glued a rectangle of sandpaper. What is the length of the strip of wood required?



Pencil Sharpener

2. What is the width of the handle in its narrowest part, if the two dotted lines are each $\frac{7}{16}$ of an inch long?

4. A boy saves $1\frac{3}{4}$¢ on a picture by doing his own developing and printing. This makes a saving of how much on each dozen pictures?

5. What is the size of the cardboard required for mounting a picture taken by Camera No. 1 if the prints are each $2\frac{1}{4}$ inches by $2\frac{1}{4}$ inches and a margin of $\frac{3}{4}$ of an inch is to be left on each of the four sides?

6. Camera No. 2 takes pictures $2\frac{1}{4}''$ by $3\frac{1}{4}''$. What is the size of cardboard required for mounting one of these pictures, if an allowance of $1\frac{1}{2}$ inches is made for a margin on each side?

7. The films for Camera No. 2 cost 25¢ for a roll of six, the developing and printing amount to 50¢ a roll. The cost per picture is how much?

8. The cost per picture is how much greater for pictures taken by Camera No. 2 than for those taken by Camera No. 1? (See problems 3 and 7.)

9. Frances Brown took with a large-sized camera 6 pictures of her aunt's house, which she sold to her aunt for 20¢ apiece. The film for each picture cost $4\frac{1}{6}$¢; the developing, $2\frac{1}{2}$¢; the printing, $3\frac{1}{2}$¢; and the cardboard mount, $4\frac{1}{2}$¢. How much money did Frances make on each picture? How much did she make in all?

*10. Henry Clarke developed and printed his own pictures. He paid 30¢ for a roll of 6 films. The material for developing, printing, and mounting the pictures taken with the roll of films was as follows: for developer, $4\frac{1}{2}$¢; for fixing-powder, $7\frac{1}{2}$¢; for printing paper and mounting cards, 15¢. How much did his pictures cost him apiece?

*11. Counting in the films, developing, and printing, George Wilson found his pictures cost him $7\frac{1}{2}$¢ apiece. Out of one lot containing $1\frac{1}{2}$ doz., 5 were failures. This raised the average cost of the successful pictures to what amount?

*12. Make and solve a problem of your own similar to problem 11.

30. Reduction of Common Fractions and Decimals

I

Express as decimals: $\frac{3}{5}$, $\frac{1}{4}$, $\frac{1}{8}$.

$1 = \frac{10}{10}, \frac{100}{100}, \frac{1000}{1000}$, etc.

$\frac{3}{5}$ of $1 = \frac{3}{5}$ of $\frac{10}{10}$, or $\frac{6}{10}$. $\frac{6}{10} = .6$.

$\frac{1}{4}$ of $1 = \frac{1}{4}$ of $\frac{100}{100}$, or $\frac{25}{100}$. $\frac{25}{100} = .25$.

$\frac{1}{8}$ of $1 = \frac{1}{8}$ of $\frac{1000}{1000}$, or $\frac{125}{1000}$. $\frac{125}{1000} = .125$.

[Write answers only.]

Express decimally:

1. $\frac{1}{2}$ inch.
2. $\frac{1}{5}$ of a minute.
3. $\frac{4}{5}$ of an hour.
4. $\frac{3}{4}$ yards.
5. $\frac{2}{5}$ of a bushel.
6. $\frac{1}{50}$ of a mile.
7. $\frac{1}{25}$ of a pound.
8. $\frac{1}{20}$ of a rod.
9. $\frac{8}{20}$ of a dollar.
10. $\frac{1}{500}$ of a ton.
11. $1\frac{1}{2}$ acres.
12. $2\frac{1}{4}$ bushels.
13. $5\frac{2}{5}$ dollars.
14. $3\frac{1}{4}$ feet.
15. $5\frac{1}{8}$ miles.

II

$\frac{1}{10}$ written decimally = .1. $\frac{10}{10}$ written decimally = 1.0.

1. Write decimally: $\frac{1}{100}, \frac{100}{100}, \frac{1}{1000}, \frac{1000}{1000}$.

What decimal is equivalent to $\frac{3}{8}$?

$$\begin{array}{r} .375 \\ 8\overline{)3.000} \end{array}$$

$\frac{3}{8} = .375$. Since 1000 is divisible by 8, in reducing $\frac{3}{8}$ to a decimal it is convenient to find $\frac{3}{8}$ of $\frac{1000}{1000}$, or, which is the same thing, $\frac{3}{8}$ of 1.000. $\frac{3}{8} \times 1.000 = \frac{3.000}{8}$, or $3.000 \div 8$.

What decimal is equivalent to $4\frac{3}{8}$?

$4\frac{3}{8} = 4 + .375$, or 4.375.

To change a common fraction to a decimal, divide its numerator by its denominator.

In pointing off the quotient, notice that the number of decimal places is the same as the number of zeros annexed to the dividend.

In reducing a common fraction to a decimal, for most purposes it is not necessary to carry the quotient more than three places. For example, $\frac{1}{70}$ may be written decimally as $.014\frac{2}{7}$, or $.014+$.

[With pencil.]

Express as decimals:

2. $\frac{5}{8}$.	7. $\frac{3}{7}$.	12. $\frac{1}{14}$.	17. $1\frac{3}{8}$.	22. $12\frac{3}{8}$.
3. $\frac{7}{8}$.	8. $\frac{1}{40}$.	13. $\frac{7}{11}$.	18. $2\frac{5}{12}$.	23. $8\frac{5}{8}$.
4. $\frac{11}{12}$.	9. $\frac{10}{80}$.	14. $\frac{1}{18}$.	19. $7\frac{8}{16}$.	24. $9\frac{7}{24}$.
5. $\frac{5}{16}$.	10. $\frac{9}{50}$.	15. $\frac{7}{15}$.	20. $4\frac{5}{24}$.	25. $6\frac{5}{11}$.
6. $\frac{1}{24}$.	11. $\frac{3}{25}$.	16. $\frac{1}{75}$.	21. $9\frac{1}{15}$.	26. $24\frac{5}{14}$.

III

In solving many problems, it is convenient to change the common fractions to decimals. For example, in adding $\frac{3}{4}$ to $\frac{1}{50}$, the sum is easily found by adding .75 to .02.

[With pencil.]

In solving the following problems, change each fraction to a decimal:

1. Find the sum of $\frac{1}{4}$ inch, $\frac{1}{2}$ inch, $1\frac{1}{10}$ inches. Of $2\frac{1}{2}$ feet, $8\frac{3}{4}$ feet, and $4\frac{3}{4}$ feet.

2. From a piece of insulated wire $14\frac{1}{2}$ ft. long, a piece $8\frac{3}{8}$ ft. long is cut. How many feet are left?

3. How many yards of muslin are left if, from $10\frac{1}{2}$ yards, I use one piece $2\frac{3}{4}$ yd. long for a curtain and another piece $1\frac{1}{8}$ yd. long for a stand cover?

4. $\frac{3}{10} + \frac{1}{2} = ?$	8. $\frac{1}{25} - \frac{1}{50} = ?$	12. $25\frac{1}{2} \times 1\frac{1}{2} = ?$
5. $\frac{1}{2} + \frac{3}{8} + \frac{3}{4} = ?$	9. $14\frac{3}{10} - 5\frac{1}{5} = ?$	13. $14\frac{1}{2} \div \frac{1}{2} = ?$
6. $2\frac{1}{4} + 5\frac{1}{2} = ?$	10. $15\frac{7}{10} \times 4 = ?$	14. $7\frac{3}{4} \div 2\frac{1}{2} = ?$
7. $3\frac{1}{8} + 4\frac{3}{10} + 9\frac{1}{4} = ?$	11. $145 \times \frac{3}{8} = ?$	15. $24\frac{1}{8} \div \frac{5}{100} = ?$

Find which of the problems below are more easily solved by the use of decimals than by the use of common fractions, then solve:

16. $\frac{7}{8} + \frac{5}{8} = ?$
17. $\frac{1}{6} + \frac{1}{3} = ?$
18. $14\frac{1}{3} + 8\frac{1}{3} = ?$
19. $\frac{9}{10} + \frac{3}{4} = ?$
20. $4\frac{1}{10} - 2\frac{3}{5} = ?$
21. $1\frac{1}{12} - \frac{1}{2} = ?$
22. $114\frac{1}{2} \times 25 = ?$
23. $175 \times 42\frac{1}{2} = ?$
24. $120 \times \frac{3}{4} = ?$
25. $12\frac{1}{2} \times \frac{1}{2} = ?$
26. $\frac{5}{16} \times \frac{4}{5} = ?$
27. $94\frac{3}{4} \times 9\frac{9}{10} = ?$
28. $18 \div \frac{3}{11} = ?$
29. $8\frac{1}{3} \div \frac{5}{6} = ?$
30. $14\frac{1}{2} \div \frac{1}{2} = ?$
31. $\frac{5}{8} \div \frac{5}{16} = ?$
32. $\dfrac{75\frac{1}{4}}{\frac{1}{4}} = ?$
33. $\dfrac{8\frac{3}{4} + 6\frac{1}{2}}{2\frac{1}{2}} = ?$
34. $\dfrac{20\frac{1}{2} - 5\frac{1}{2}}{\frac{7}{10}} = ?$

35. Find the cost of 10 lb. of nails at $4\frac{1}{2}$¢ a pound. Of $3\frac{1}{2}$ lb. at 5¢ a pound.

36. From a board 15.5 feet long, two lengths are cut. One is $8\frac{1}{4}$ feet long; the other, $4\frac{1}{2}$ feet. Find the number of feet left.

IV

What part of a yard equals .875 yards?

$.875 = \frac{875}{1000}$. $\frac{875}{1000}$ reduced to lowest terms equals $\frac{7}{8}$.
.875 yards = $\frac{7}{8}$ of a yard.

To reduce a decimal to a common fraction, write its numerator over its denominator as in a common fraction, then reduce the fraction to its lowest terms.

[Use pencil only when needed.]

Express as a common fraction:

1. .6
2. .4
3. .80
4. .60
5. .35
6. 1.5
7. 2.8
8. 3.50
9. 4.75
10. 6.25
11. .125
12. .375
13. .025
14. .005
15. .0625
16. .075
17. .0025
18. .0875
19. .0075
20. .00125
21. 8.625
22. 3.025
23. 14.005
24. 64.875
25. 18.0125

31. Problem Test

[Without pencil.]

1. A rectangle 8″ by 12″ is to be drawn to a scale of $\frac{1}{4}$″ to 1″. What should be the dimensions of the drawing?

2. A line 9 inches long is to be marked off into spaces each $1\frac{1}{2}$ inches long. Find the number of spaces.

3. Ribbon is bought in two remnants. One contains $2\frac{5}{8}$ yards; the other, $3\frac{1}{4}$ yards. How many yards are there in the two pieces?

4. From 10 yards of lawn, $3\frac{1}{2}$ yards are used for a cooking apron, and $\frac{3}{4}$ of a yard for a cap. How many yards are left in the piece?

5. Find how much more must be paid for $\frac{2}{3}$ of a yard of linen at $1.80 a yard than for the same amount at $1.50 a yard.

[With pencil.]

6. Three boards are nailed side by side. One is $5\frac{3}{4}$″ wide; another, $6\frac{7}{8}$″ wide; and the third, $7\frac{5}{16}$″ wide. What is their combined width?

7. A cover to a box is to be made 18 inches wide. Three boards are used. The first is $7\frac{3}{4}$″ wide; the second, $5\frac{1}{2}$″ wide. How wide must the third board be, in order to have the three equal the width of the cover?

8. Molding for two picture frames is to be bought. For one, $6\frac{1}{2}$ feet are bought at 9¢ a foot; for the other, $7\frac{3}{4}$ feet at 10¢ a foot. Find the cost.

9. From 15 yards of crash, $2\frac{1}{2}$ yards are cut for a bureau scarf. From the piece left, towels are cut $1\frac{1}{4}$ yards long. How many such towels can be cut from it?

10. Find the waste left from a board $16\frac{1}{2}$ ft. long after 3 shelves of the same width as the board have been cut from it, each $3\frac{2}{3}$ ft. long.

32. Progress Score

With the help of these exercises measure your work in computing for the half year. Try to make 100 points on each exercise, or a total of 400 points. Count for each correct answer the score given in parenthesis below the letter of the problem.[1]

I. Addition

[Copy numbers only when necessary.]

Add:

A. $3.78	B. 14.29	C. .86	D. 554	E. 6	F. 19
(3) 6.49	(3) 3.647	(4) .475	(6) 837	(5) 7	(10) 18
3.25	15.49	.325	664	4	29
			930	3	27
			449	9	19
			368	8	47
G. $\frac{8}{16}$	H. $\frac{7}{9}$	I. $4\frac{5}{12}$	J. $6\frac{7}{8}$	230	6	39
(3) $\frac{9}{16}$	(3) $\frac{5}{9}$	(4) $8\frac{5}{12}$	(6) $9\frac{5}{8}$	898	0	18
				649	7	17
					9	28
					8	27
K. $7\frac{3}{4}$	L. $4\frac{2}{5}$	M. $2\frac{5}{6}$	N. $9\frac{2}{3}$		7	18
(5) $8\frac{1}{12}$	(7) $3\frac{5}{6}$	(7) $7\frac{5}{8}$	(6) $8\frac{5}{6}$		5	16
					8	17

O. $14\frac{5}{12} + 21\frac{3}{4} + 8\frac{1}{3} = ?$
(9)

P. $1.42 + 64¢ + 7¢ + $1.04 + $2 = ?
(7)

Q. $2.15 + 3\frac{3}{4} + 7\frac{1}{2} = ?$
(12)

II. Subtraction

[Copy numbers only when necessary.]

Subtract:

A. $5.15	B. 12.42	C. 87423	D. 4000	E. 320400
(4) 2.98	(5) 8.9	(5) 2706	(6) 1764	(7) 48397

[1] Find your average mark on the four tests in this exercise and keep a record of it. Compare it with your record on the progress score at the end of the year's work.

F. $14\frac{11}{16}$
(5) $6\frac{5}{16}$

G. $24\frac{3}{4}$
(6) $9\frac{5}{12}$

H. $15\frac{11}{12}$
(7) $6\frac{5}{8}$

I. $12\frac{1}{8}$
(8) $7\frac{1}{15}$

J. 16
(7) $5\frac{3}{4}$

K. $19\frac{1}{8}$
(10) $15\frac{3}{8}$

L. $17\frac{1}{2}$
(10) $12\frac{3}{4}$

M. 24.6 − 8.72 = ?
(8)

N. $36.24 - 21\frac{3}{5}$ = ?
(12)

III. Multiplication

[Copy numbers only when necessary.]

Multiply:

A. 7089
(3) 7

B. 690
(4) 58

C. 458
(4) 306

D. $7.25
(5) 320

E. $\frac{3}{8}$ of 24 = ?
(3)

F. $\frac{2}{3}$ of 16 = ?
(4)

G. $18 \times \frac{5}{12}$ = ?
(5)

H. $\frac{3}{8} \times \frac{5}{6}$ = ?
(5)

I. $3\frac{3}{4} \times \frac{2}{3}$ = ?
(6)

J. $5\frac{1}{4} \times 3\frac{1}{2}$ = ?
(8)

K. $21\frac{1}{3}$
(5) 6

L. $14\frac{2}{7}$
(6) 5

M. 28
(8) $2\frac{3}{4}$

N. 28
(8) $4\frac{1}{6}$

O. 7.44
(4) 3

P. 428
(5) .04

Q. .035
(7) 2.1

R. $7.16 × $.2\frac{1}{4}$ = ?
(10)

IV. Division

[Copy numbers only when necessary.]

Find quotients:

A. 6)$214.75
(5)

B. 82)33292
(5)

C. 57)39330
(6)

D. $7 \div \frac{3}{8}$.
(6)

E. $\frac{3}{8} \div \frac{3}{3}$.
(6)

F. $\frac{4}{5} \div 3$.
(6)

G. $6\frac{3}{4} \div 1\frac{7}{8}$.
(10)

H. 25)$60.55
(7)

I. 85)9112
(9)

J. 400)$36
(10)

K. $.08)$98.72
(8)

L. .32)480
(10)

M. $8.8 \div 3\frac{1}{5}$ = ?
(12)

CHAPTER IV. COMPUTING FACTS ABOUT THE UNITED STATES

33. The Use of Large Numbers

I

In almost every newspaper, in magazines, in books, and in government reports, are found interesting facts about our country, expressed in figures. In order to understand these facts, it is necessary to know how to read large numbers.

According to the last census, the wealth of the country in real estate and personal property had increased in ten years from $88,517,306,000 to approximately $107,000,000,000.

$88,517,306,000 is read 88 billion, 517 million, 306 thousand dollars.

$107,000,000,000 is read 107 billion dollars.

Billions	Millions	Thousands	Units
88,	517,	306,	000
107,	000,	000,	000

In the numbers above, what name is given to the figures in the first period, counting from the right? To the figures in the second period? To those in the third? To those in the fourth?

Read:

1. 245,000.
2. 1,000,000.
3. 24,000,000.
4. 5,400,000.
5. 114,217,000.
6. 1,424,234.
7. 24,275,135.
8. 400,000,000.
9. 1,000,000,000.
10. 25,500,000,000.
11. 72,400,200,000.
12. 525,420,000,500.
13. 1,640,375,281.
14. 5,000,000,000.

15. Read:

SIXTY YEARS PROGRESS IN THE UNITED STATES

	1850	1910
Area in square miles (continental U. S. only)	2,997,119	3,026,789
Population	23,191,876	92,174,515
Gold coined	$31,981,739	$104,723,735
Silver coined	$1,866,100	$3,740,468
Miles of Railway	9,021	244,084
Number of Post Offices	18,417	59,580
Value of Imports	$173,509,526	$1,556,947,430
Value of Exports	$144,375,726	$1,744,984,720
Deposits in Savings Banks	$43,431,130	$4,070,486,247

16. Be prepared to write from dictation numbers taken from your geographies.

17. Find in your geography an interesting statement containing a large number. Be ready to read it to your class.

34. Tests for Speed and Accuracy

Use these tests to measure your speed and accuracy with integers.

[Copy numbers only when necessary.]

Test No. 12. Add. Time limit, 3 minutes

A. 3765
2483
6759
4528
3677

B. 54236
4275
18326
735
5329

C. 7
6
5
4
3
2
7
5
9
8
6
9

D. 673
245
367
438
635
748
326
543
538

Test No. 13. Subtract. Time limit, 40 seconds.

E. 15645
7839

F. 8000
2132

G. 74906
3829

Test No. 14. Time limit, 2½ minutes.

H. 6709	I. 748	J. 390	K. 861
9	80	67	375

Test No. 15. Time limit, 5 minutes.

L. $90\overline{)42570}$ M. $721\overline{)37492}$ N. $59\overline{)38350}$ O. $168\overline{)13104}$

If, within the time limit, you failed to get the correct answers to all of the problems in any of the tests above, use for practice the problems on pages 272–275 of the kind that delayed you, then try the test again.

If you had no trouble with the tests, improve your power of computing by solving these problems.

*1. $1728 \times 6040 = ?$

*2. $15{,}750 \times 412 = ?$

*3. $72{,}564 \times 1325 = ?$

*4. $25{,}000 \div 5280 = ?$

*5. $100{,}000 \div 2240 = ?$

*6. $1{,}500{,}000 \div 1728 = ?$

35. Area of the United States

[With pencil.]

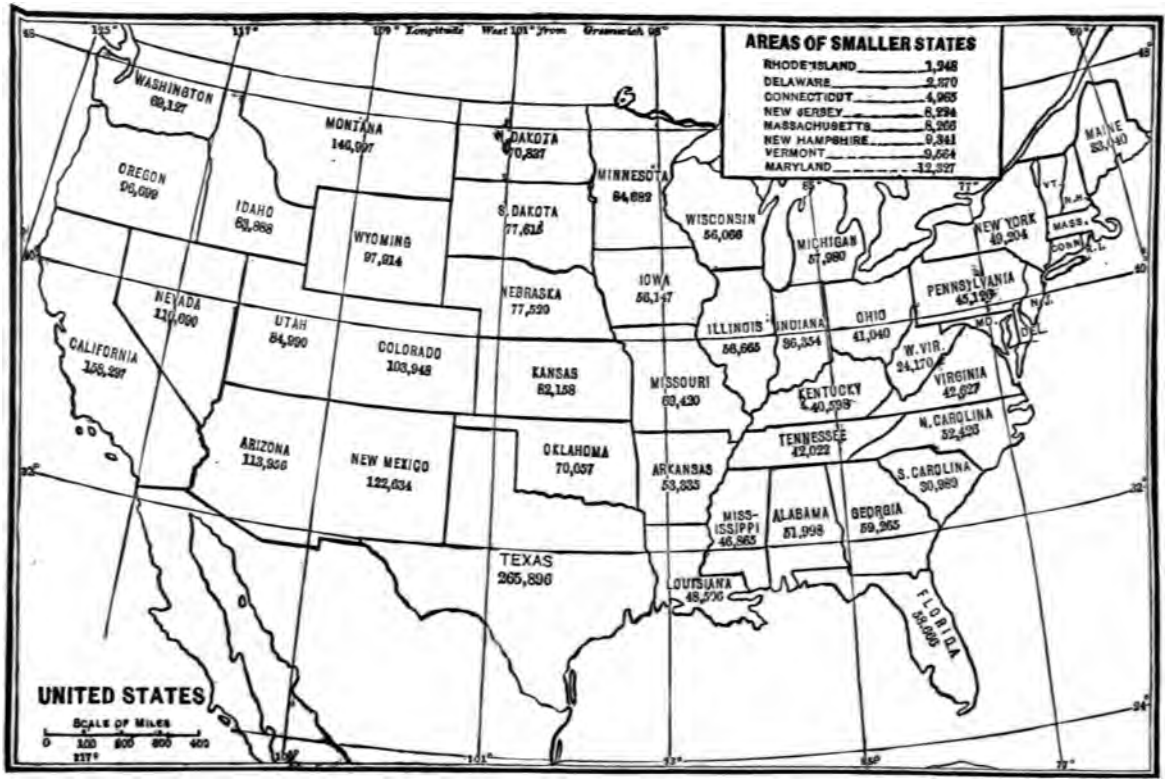
1. With the help of the map on page 204, write the names of the five smallest states with the area of each. Write the names and the areas of the five largest states.

2. Alaska contains 590,884 square miles. It contains how many more square miles than Texas?

3. The two largest states along the Atlantic seacoast are Georgia and Florida. First estimate, and then find, how many more square miles California contains than these two states together.

4. The largest state bordering the Mississippi river is Minnesota. The area of Minnesota is how much greater than that of the six New England States?

5. The area of what New England States combined can be included in the area of Illinois?


AREAS OF SMALLER STATES
RHODE ISLAND 1,948
DELAWARE 2,370
CONNECTICUT 4,965
NEW JERSEY 8,224
MASSACHUSETTS 8,266
NEW HAMPSHIRE 9,341
VERMONT 9,564
MARYLAND 12,327
WASHINGTON 68,127
OREGON 96,699
IDAHO 83,888
MONTANA 146,997
WYOMING 97,914
N. DAKOTA 70,837
S. DAKOTA 77,615
NEBRASKA 77,520
NEVADA 110,690
UTAH 84,990
COLORADO 103,948
CALIFORNIA 158,297
ARIZONA 113,956
NEW MEXICO 122,634
KANSAS 82,158
OKLAHOMA 70,057
TEXAS 265,896
MINNESOTA 84,682
IOWA 56,147
MISSOURI 69,420
ARKANSAS 53,335
LOUISIANA 48,506
WISCONSIN 56,066
ILLINOIS 56,665
MICHIGAN 57,980
INDIANA 36,354
OHIO 41,040
KENTUCKY 40,598
TENNESSEE 42,022
MISSISSIPPI 46,865
ALABAMA 51,998
GEORGIA 59,265
FLORIDA 58,666
S. CAROLINA 30,989
N. CAROLINA 52,426
VIRGINIA 42,627
W. VIR. 24,170
PENNSYLVANIA 45,126
NEW YORK 49,204
MAINE 33,040
VT.
N.H.
MASS.
CONN.
R.I.
N.J.
MD.
DEL.
UNITED STATES
SCALE OF MILES
0 100 200 300 400

6. Compare the area of your own state with that of three others.

7. Make at least one other comparison that interests you.

8. The area of the United States east of the Mississippi is 881,476 sq. mi.; the area west of it is 2,145,313 sq. mi.; the area of Alaska is 590,884 sq. mi. What is the entire area of continental United States including Alaska?

9. The area of the islands belonging to the United States is as follows: the Philippine Islands, 115,026 sq. mi.; Porto Rico, 3435 sq. mi., Hawaii, 6449 sq. mi.; Tutuila and islets, 77 sq. mi.; Guam, 210 sq. mi. How many square miles do our islands include?

10. The Panama Zone includes 436 sq. mi. What is the entire area of the United States, including the states and the territory of the mainland, the island possessions, and the Panama Canal Zone?

*11. The area of the United States before the Spanish American War (1898) was 3,624,122 sq. mi. Its area has been increased by how many miles since that time?

36. The Five Great Lakes

[With pencil.]

1. The five Great Lakes are among the largest in the world. Find from the table below their total area:

	AREA IN SQUARE MILES	GREATEST LENGTH IN MILES	GREATEST WIDTH IN MILES	HEIGHT ABOVE SEA LEVEL IN FEET
Superior	30,829	390	160	602
Michigan	21,729	345	84	582
Huron	22,322	270	105	582
Erie	9,990	250	60	573
Ontario	7,104	190	52	247

2. Traveling at the rate of 20 miles an hour, how many hours does it take a steamboat to go the length of Lake Superior? Of each of the other Great Lakes?

3. The greatest difference in height above sea level of two adjoining lakes is that between Lake Erie and Lake Ontario. What is the difference?

4. This drop between the heights of the two lakes makes Niagara Falls. The height of the highest waterfall at Niagara is equal to one half of this drop. What is its height?

5. What is the difference between the heights above sea level of Lake Superior and of Lake Ontario?

6. Make and solve three problems comparing by subtraction the areas of the different lakes.

7. Make and solve two problems comparing their width.

*8. The area of Lake Superior is how many times as great as the area of Lake Ontario? As that of each of the other Great Lakes?

37. Niagara Falls

[With pencil.]

1. The water from Lake Superior, Lake Michigan, Lake Huron, and Lake Erie pours over the cliff at Niagara on its way to the ocean. Lake Superior drains 85,000 sq. mi. of territory; Lake Michigan, 70,040 sq. mi.; Lake Huron, 74,000 sq. mi.; and Lake Erie, 39,680 sq. mi. From how large a drainage area does the water of Niagara Falls come?

2. When the water in the lakes is at its lowest level, 176,000 cubic feet of water pour over the cliff at Niagara each second. If a cubic foot of water weighs $62\frac{1}{2}$ lb., what is the weight in tons of this volume of water?

3. The pouring of the water over the cliff has worn a deep gorge. Each year the gorge is made about 5 ft. longer. At this rate, how many years, approximately, does it take the falls to cut a mile of gorge?

*4. The gorge made by Niagara Falls is 7 miles long. Taking 5 ft. as an average for the length of the new cutting each year, what is the estimate for the time the falls have taken to cut the entire gorge?

38. The Rivers of the United States

[With pencil.]

1. The longest rivers in the United States are: the Mississippi, 3160 miles long; the Missouri, 3100 miles long; the Arkansas, 2170 miles long; the Yukon, 2000 miles long; the Rio Grande, 1800 miles long; and the Colorado, 1360 miles long. Compare by subtraction the length of each of the four shorter ones with that of the Mississippi.

2. When the main stream of the Missouri river is considered as a part of the Mississippi, the whole water course is 4300 miles long. How much longer is the combined river than the Mississippi alone?

3. The navigable length of the Mississippi river is 2429 miles. Find the number of days required to go this length in a steamer traveling at the rate of 210 miles a day.

4. The chief tributaries of the Mississippi are the Missouri, which drains an area of 527,155 sq. mi.; the Ohio, which drains 201,720 sq. mi.; and the Arkansas, which drains 185,671 sq. mi. The main stream with its smaller tributaries drains 342,454 sq. mi. What is the area of the entire region drained by the Mississippi?

*5. The area drained by the five Great Lakes is 298,480 square miles. Compare by division the area drained by these with that drained by the Mississippi river.

*6. The largest river valley in Europe, the Volga, contains 563,300 sq. mi.; the largest in Asia, the Yenesei, contains 1,500,000 sq. mi. Compare by subtraction the area of the Mississippi valley with that of each of these great river valleys.

39. Our Mountains

[Use pencil only when needed.]

1. The highest known mountain in the western part of the United States, exclusive of Alaska, is Mt. Whitney, California. This mountain is 14,898 ft. high. The highest mountain in the eastern part, Mt. Mitchell in North Carolina, is 6711 feet high. What is the approximate difference in the heights of the two mountains? What is the exact difference?

An *approximate* answer is one given in "round numbers." In this case, the approximate difference would be 15,000 ft. − 7000 ft., or — ft.

2. Mt. Mitchell is supposed to have been at one time 12,000 feet high. If this is true, how many feet has it worn down? Its present height is approximately what part of its former height?

3. The highest known mountain in North America is Mt. McKinley in Alaska. This mountain is 20,464 feet high. What is its height in miles and feet?

4. The tables below give the height in feet of some of the best known mountains in our country. Give the approximate height of each in miles, then choose three mountains and find the exact height of each in miles and feet.

Mt. Washington, N.H..	6293 ft.	Mt. Rainier, Wash....	14,526 ft.
Mt. Marcy, N.Y.....	5344 "	Mt. Shasta, Cal.....	14,380 "
Pike's Peak, Colo.....	14,108 "	Mt. St. Elias, Alaska.	18,025 "

*5. The highest mountain in Europe, Mt. Blanc, is 15,781 ft. in height. The difference between the height of this mountain and that of Mt. McKinley is approximately what part of a mile?

CHAPTER V. COMPARISON OR RATIO

40. Comparison of Integers

I

[Without pencil.]

1. What part of a dollar is 25¢? 50¢? 75¢?

2. A line 36 inches long is how many times the length of a 9-inch line? Of a 12-inch line?

3. Compare 40 minutes with 20 minutes. 15 minutes with 30 minutes. 8 hours with 24 hours.

4. Out of $25, I spend $15. What part of the money do I spend?

Since $1 = \frac{1}{25}$ of $25, $15 = $\frac{15}{25}$ of $25. $\frac{15}{25}$ reduced to lowest terms = ? The part spent is —.

5. A package weighing 14 pounds is how many times as heavy as one weighing 10 pounds?

Since 1 lb. = $\frac{1}{10}$ of 10 lb., 14 lb. = $\frac{14}{10}$ of 10 lb. $\frac{14}{10}$ reduced = ? The package weighing 14 lb. is — times as heavy as one weighing 10 lb.

The comparison of two quantities answering the questions *what part* or *how many times* is called **ratio.**

Ratio is a form of division. The ratio of 15 to 25 equals 15 ÷ 25, or $\frac{15}{25}$. $\frac{15}{25} = \frac{3}{5}$. The ratio of 14 to 10 equals 14 ÷ 10, or $\frac{14}{10}$. $\frac{14}{10} = \frac{7}{5}$, or $1\frac{2}{5}$.

6. Name the fraction that expresses the comparison, or ratio, of 12 to 18. Reduce it to its simplest form.

7. Name the fraction that expresses the comparison, or ratio, of 50 to 20. Reduce it to its simplest form.

8. State clearly how the comparison, or ratio, of two numbers is found.

9. Express the comparison or ratio of 15 to 20. Of 12 to 8. Of 32 to 40. Of 27 to 36. Of 48 to 30.

Compare:

10. 8 in. with 12 in.
11. 15 ft. with 18 ft.
12. 20 yd. with 25 yd.
13. 14 oz. with 16 oz.
14. 20 lb. with 50 lb.
15. 24 in. with 12 in.
16. 50 ft. with 40 ft.
17. 21 yd. with 9 yd.
18. 45 min. with 30 min.
19. 24 hr. with 18 hr.
20. 12 yd. with 36 yd.
21. 30 ft. with 36 ft.
22. 40 lb. with 30 lb.
23. 56 hr. with 32 hr.
24. 96 da. with 84 da.
25. 14 wk. with 35 wk.

II

By the use of comparison, or ratio, the solution of many problems is shortened.

At the rate of 3 for 25¢, how much must be paid for 1 dozen roses?

12 roses are 4 times 3 roses, and cost 4 times 25¢, or $1.00.

Find how much must be paid: [Without pencil.]

1. For 24 geraniums selling at 4 for $1.00.
2. For 18 tulip bulbs selling at 40¢ a dozen.
3. For 8 oranges selling at 60¢ a dozen.
4. For 1 dozen bananas selling at 3 for 10¢.
5. For 1½ dozen lemons selling at 3 for 10¢.
6. For 2½ dozen fruit jars selling at 6 for $1.00.
7. For 9 jelly glasses selling at 40¢ a dozen.
8. For 4 bars of soap selling at 2 for 25¢.
9. For 25 paper napkins selling at 35¢ a hundred.
10. For 1½ dozen paper cups selling at 2 for 5¢.
11. For 3 dozen picnic plates selling at the rate of 6 dozen for $1.00.

12. For 4 note books selling at 2 for 15¢.

13. For 24 sheets of cardboard selling at 2 sheets for 5¢.

14. For 12 sheets of tissue paper selling at 3 sheets for 5¢.

15. For 1000 envelopes selling at 40¢ a hundred.

16. For 1 dozen collars selling at 2 for 25¢.

17. At the rate of $6.00 for 9 hours' work, how much must be paid for 3 hours' work?

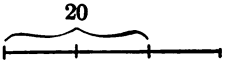
18. At the rate of $4.00 for 8 hours' work, how much must be paid for 6 hours' work?

19. A man receives $5 a day for 8 hours of work. What are his weekly wages when he works 48 hours? When he works 54 hours?

20. How much more does a man receive for 48 hours of work when he is paid $8 for a day of 8 hours than when he is paid $6 a day?

41. Finding a Whole Number When a Part is Given [1]

In setting out a row of raspberry bushes, 20 bushes were required for $\frac{2}{3}$ of the length of the row. At the same rate, how many bushes were required for the entire row?



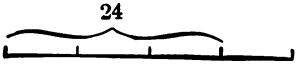
Since $\frac{2}{3}$ of the number of bushes is 20 bushes, $\frac{1}{3}$ of the number is $\frac{1}{2}$ of 20 bushes, or 10 bushes; and $\frac{3}{3}$, or the whole number, is 3 times 10 bushes, or 30 bushes.

By using the ratio of the whole to the part, this explanation may be shortened:

Since $\frac{3}{3}$, or the whole number, is $\frac{3}{2}$ of $\frac{2}{3}$, the whole number is $\frac{3}{2}$ of 20, or 30.

[1] This type of problem is important in that it forms the basis for some of the work in percentage. It is, however, a difficult one for some pupils to grasp. Clearness can be gained by objective work with lines and rectangles, and by having the children master the two methods of solution — the one for its clearness, the other for its brevity. However, even with these precautions, there will occasionally be a child who is confused by such expressions as "$\frac{1}{3}$ is $\frac{1}{2}$." (See first explanation above.) In his case, it will be found helpful to substitute the word *part* for the denominator of the fraction. The explanation would run: "Since 2 *parts* are 20, 1 part is $\frac{1}{2}$ of 20, or 10; and 3 parts, or the whole, are 3 times 10, or 30."

[Use pencil for drawings only.]



1. John has saved $24. This is $\frac{3}{4}$ of the amount needed to cover the expenses of a vacation trip. How much is the trip to cost? (Explain in two ways.)

2. Three fifths of the distance between two cities is 300 miles. Show by a drawing what the entire distance between them is.

3. A baseball team won 15 games. This was five sixths of the entire number played. How many games were played?

4. Eleven twelfths of the number of children belonging to a schoolroom were promoted. The number promoted was 33. How many children belonged to the room?

Find the number of which:

5. $\frac{3}{8}$ is 12.	8. $\frac{5}{6}$ is 25.	11. $\frac{8}{10}$ is 18.	14. $\frac{8}{16}$ is 6.
6. $\frac{3}{4}$ is 15.	9. $\frac{4}{7}$ is 28.	12. $\frac{4}{11}$ is 44.	15. $\frac{5}{24}$ is 15.
7. $\frac{5}{8}$ is 20.	10. $\frac{8}{9}$ is 16.	13. $\frac{7}{12}$ is 21.	16. $\frac{3}{25}$ is 4.

Using the short method, find the number of which:

17. $\frac{1}{2}$ is 11.	22. $\frac{1}{6}$ is 12.	27. $\frac{2}{9}$ is 18.	32. $\frac{5}{12}$ is 60.
18. $\frac{3}{4}$ is 9.	23. $\frac{4}{5}$ is 24.	28. $\frac{5}{9}$ is 30.	33. $\frac{11}{12}$ is 77.
19. $\frac{3}{8}$ is 16.	24. $\frac{3}{7}$ is 16.	29. $\frac{1}{10}$ is 12.	34. $\frac{1}{20}$ is 3.
20. $\frac{3}{5}$ is 15.	25. $\frac{5}{7}$ is 60.	30. $\frac{8}{10}$ is 63.	35. $\frac{7}{20}$ is 28.
21. $\frac{7}{8}$ is 42.	26. $\frac{8}{7}$ is 30.	31. $\frac{8}{11}$ is 36.	36. $\frac{5}{21}$ is 15.

42. Summary: The Whole and the Part

There are three kinds of problems with which you have become familiar that need to be thought of in their relation to one another. They are: (1) Finding the part of a number when the whole number is given; (2) finding the whole number when a part is given; and, (3) comparing a part of a number with the whole. You will have

continual use for these three kinds of problems in the business studies contained in the later chapters of this book.

[Without pencil.]

FINDING PART OF A NUMBER

1. $\frac{4}{5}$ of 20 = ?
2. $\frac{7}{8}$ of 64 = ?
3. $\frac{5}{12}$ of 72 = ?
4. $\frac{3}{8}$ of 48 = ?
5. $\frac{3}{4}$ of 60 = ?
6. $\frac{2}{5}$ of 75 = ?
7. $\frac{1}{3}$ of 72 = ?
8. $\frac{1}{6}$ of 150 = ?
9. $\frac{5}{8}$ of 120 = ?
10. $\frac{3}{8}$ of 40 = ?
11. $\frac{3}{4}$ of 30 = ?
12. $\frac{7}{8}$ of 45 = ?

FINDING THE WHOLE NUMBER WHEN A PART IS GIVEN

13. 15 = $\frac{1}{3}$ of —.
14. 12 = $\frac{3}{4}$ of —.
15. 18 = $\frac{3}{5}$ of —.
16. 20 = $\frac{2}{3}$ of —.
17. 25 = $\frac{5}{8}$ of —.
18. 32 = $\frac{4}{5}$ of —.
19. 60 = $\frac{5}{6}$ of —.
20. 45 = $\frac{5}{12}$ of —.
21. 32 = $\frac{4}{9}$ of —.
22. 7 = $\frac{1}{12}$ of —.
23. 49 = $\frac{7}{8}$ of —.
24. 9 = $\frac{8}{16}$ of —.

COMPARING THE PART WITH THE WHOLE

25. 12 is what part of 16?
26. 18 is what part of 27?
27. 42 is what part of 49?
28. 40 is what part of 60?
29. 54 is what part of 63?
30. 36 is what part of 48?
31. 33 is what part of 55?
32. 72 is what part of 96?
33. 72 is what part of 81?
34. 108 is what part of 144?

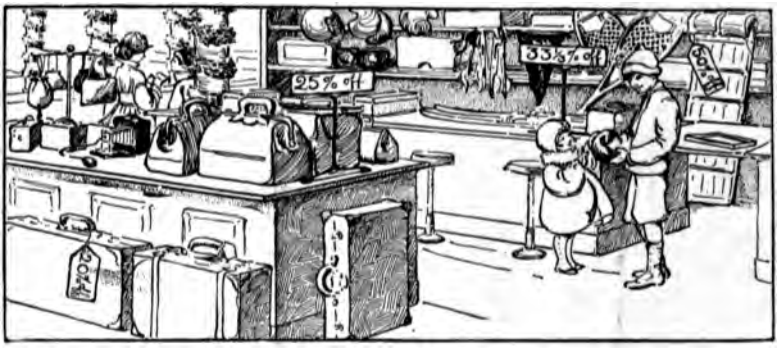
COMBINATION PROBLEMS

35. $\frac{3}{4}$ of 16 is $\frac{2}{3}$ of what number?
36. $\frac{7}{8}$ of 24 is $\frac{3}{8}$ of what number?
37. $\frac{9}{10}$ of 70 is $\frac{7}{8}$ of what number?
38. $\frac{5}{6}$ of 36 is $\frac{3}{10}$ of what number?
39. $\frac{4}{11}$ of 66 is $\frac{3}{4}$ of what number?
40. $\frac{4}{5}$ of 20 is what part of 24?
41. $\frac{3}{8}$ of 32 is what part of 15?
42. $\frac{3}{4}$ of 24 is what part of 27?
43. 12 is what part of $\frac{5}{6}$ of 24?
44. 18 is what part of $\frac{3}{4}$ of 36?

*45. Find the number that, when increased $\frac{1}{3}$, equals $\frac{1}{2}$ of 800.

CHAPTER VI. PERCENTAGE

43. The Meaning of Per Cent



To attract trade, merchants sometimes sell their goods at reduced prices. A reduction of $\frac{1}{4}$ off means that an article marked to sell for $4.00 will be sold for $1.00 less than the price at which it is marked; that is, it will be sold for $3.00.

1. Name articles that you have seen advertised for sale at reduced prices. How did the merchants show that the prices were reduced?

The part of the price taken off is often reckoned by decimal fractions in the hundredths and called **per cent**. A reduction of 5 cents on $1.00, or $\frac{5}{100}$, is called 5 per cent.

The words *per cent* come from the Latin words *per centum* meaning *by the hundred*, hence a given per cent has come to mean so many out of a hundred, or so many hundredths.

A reduction of 10¢ on $1.00 = $\frac{10}{100}$ (.10) or 10 per cent.
A reduction of 25¢ on $1.00 = $\frac{25}{100}$ (.25) or 25 per cent.
A reduction of 40¢ on $2.00 = $\frac{20}{100}$ (.20) or 20 per cent.

[Use pencil only when needed.]

2. A reduction of 7¢ on $1.00 is a reduction of how many hundredths? Of what per cent?

3. A reduction of 12¢ on $2.00 is a reduction of how many cents on a dollar? Of how many hundredths? Of what per cent?

4. A suitcase marked $6.00 is for sale at a reduction of 60¢. This reduction equals how many cents on a dollar? What per cent?

5. A camera marked $5.00 is for sale at a reduction of 40¢. The reduction equals how many cents on a dollar? What per cent?

6. Express as a per cent a reduction of 30¢ on $1.00. A reduction of 18¢ on $2.00. A reduction of 15¢ on $3.00.

Per cents are often used to express other facts than the amount taken off in marking down prices.

7. From a school containing 400 children, 20 pupils were absent. This was how many pupils per hundred? What per cent?

8. A farmer raised 600 bushels of potatoes. Out of this number, he kept 30 bushels for his own use. The number of bushels kept was how many out of each hundred bushels raised? What per cent?

9. A young man earned $800 a year, out of which he saved $240. This was how many dollars out of each hundred? What per cent?

The sign for per cent is %.

5 per cent is written 5%.

10. Express as a per cent, using the sign:

$$\frac{6}{100}, \frac{11}{100}, \frac{75}{100}, \frac{60}{100}, \frac{33\frac{1}{3}}{100}, \frac{150}{100}.$$

Three per cent, or its equivalent, may be written: 3 per cent, 3%, 3 hundredths, $\frac{3}{100}$, and .03.

11. Write six per cent, or its equivalent, in five different ways.

12. Write ten per cent, or its equivalent, in six different ways.

13. Write as decimal fractions:

12 per cent.	1 per cent.	3%.	$12\frac{1}{2}$%.
25 per cent.	8 per cent.	6%.	$3\frac{1}{2}$%.
50 per cent.	4 per cent.	20%.	$37\frac{1}{2}$%.
35 per cent.	2 per cent.	5%.	$83\frac{1}{3}$%.
95 per cent.	7 per cent.	10%.	125%.

44. Finding a Percentage

I

[Without pencil.]

1. In a package containing 500 sheets of paper, 3 out of each hundred, or 3 per cent, were imperfect. How many sheets were imperfect?

2. In his collection of 200 foreign stamps, John found that 4 out of each 100 stamps, or 4%, were Italian stamps. How many Italian stamps did he have?

3. Margaret is making a collection of postal cards of famous places in America. She has in all 300 postal cards. Of this number 5% show pictures of Yellowstone Park. How many of her postal cards show pictures of Yellowstone Park.

In finding a given per cent of a number, the answer is often spoken of as a **percentage.**[1]

4. Find 2 per cent of 300 books. What is the percentage?

5. What is the percentage when 3 per cent of $400 is found? When 2% of 700 miles is found?

6. What is the percentage when 5% of 400 men is taken?

A convenient way of finding a percentage of a number mentally is to point off two places in the number to show what one per cent equals, and then to multiply by the given number of per cent. To find 5% of 400 men, 1% is thought of as 4 (4.00) men, and 5% as 5 times 4 men, or — men.

[1] The number of which the percentage is a part is called the *base*. Unless the use of this term is desired by the teacher, it may be omitted as unnecessary.

7. A young man earned $500 and saved 8% of it. What was the percentage saved?

8. A farmer had $600 in a bank. He took out 4% of it. What was the percentage taken out?

Name the percentages found by taking:

9. 2% of 200. Of 1500.
10. 3% of 400. Of 6000.
11. 4% of 110. Of 4000.
12. 5% of 300. Of 1100.
13. 6% of 800. Of 2000.
14. 7% of 210. Of 1200.
15. 8% of 100. Of 500.
16. 9% of 200. Of 2000.
17. 10% of 400. Of 1000.
18. 12% of 300. Of 1200.

II

A school containing 400 children had its membership increased 5 per cent. What was the new membership?

5% of 400 children = 20 children.
400 children + 20 children = 420 children.
The new membership was 420 children.

[Without pencil.]

1. A village containing 800 people increased in population 2%. What was its new population?

2. A library containing 500 volumes was increased 10%. How many books did it then contain?

3. Increase 200, 4 per cent; 300, 2 per cent; 400, 2 per cent.

4. What is the amount when $600 is increased 3%? When $500 is increased 5%? When $900 is increased 2%?

III

Out of my savings amounting to $300, I spend 4%. How much money have I left?

4% of $300 = $12. $300 − $12 = $288. $288 = the money left.

[Without pencil.]

1. What is the attendance at school when, out of a membership of 500 pupils, 2% are absent?

2. A boy had 300 marbles. He lost 5% of them. How many did he have left?

3. How much is left after 5% is taken from $200? After 3% is taken from $300? After 2% is taken from $600?

Increase:

4. 300, 1%.
5. 400, 7%.
6. 200, 2%.
7. 500, 3%.
8. 200, 6%.
9. 8000, 10%.

Decrease:

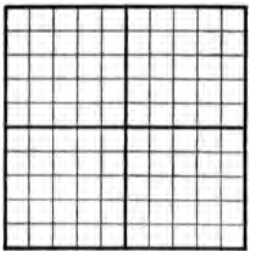
10. 200, 10%.
11. 400, 1%.
12. 300, 3%.
13. 500, 2%.
14. 200, 4%.
15. 700, 3%.

45. Fractional Parts and Equivalent Per Cents

I

In solving problems in percentage, it is often convenient to express different fractional parts as per cents, and different per cents as fractional parts. With the help of this diagram, a number of the most common equivalents can be found.

[Without pencil.]



1. The diagram contains 100 small squares. One of these squares is what part of the diagram? What per cent of it?

2. One half of the diagram equals how many hundredths of it? What per cent of it?

3. One fourth of the diagram equals how many hundredths of it? What per cent?

4. Three fourths of the diagram equals how many hundredths of it? What per cent?

5. Express as a per cent: $\frac{1}{2}$; $\frac{1}{4}$; $\frac{3}{4}$.

6. Express as a fraction: 25%; 50%; 75%.

7. A boy has saved 50% of the amount necessary to buy a printing press. What part of the money needed has he saved?

8. A girl's father helped her to buy a writing desk by paying 25% of the cost. What part was left for her to pay? What per cent?

9. Study the diagram and find the per cents that stand for other fractional parts, such, for example, as $\frac{1}{10}$ and $\frac{8}{10}$.

II

(1) What per cent of a quantity is $\frac{2}{5}$ of it?

Since in one whole there is $\frac{100}{100}$, or 100%, in $\frac{2}{5}$ of a quantity there is $\frac{2}{5}$ of 100%, or 40%.

(2) What fractional part of a number equals 70% of it?

$70\% = \frac{70}{100}$. $\frac{70}{100}$ reduced to lowest terms $= \frac{7}{10}$.

1. With the help of the first solution above, tell how to find the per cent that equals a given fractional part.

2. With the help of the second solution, tell how to find the fractional part that equals a given per cent.

[Without pencil.]

3. Express as a per cent: $\frac{1}{10}$; $\frac{8}{10}$; $\frac{9}{10}$; $\frac{1}{5}$; $\frac{3}{5}$; $\frac{4}{5}$.

4. One tenth of a man's salary was used for rent. What per cent was used?

5. Three fifths of a boy's earnings was put into a savings bank. What per cent was put in?

6. Express as a fractional part: 10%, 20%, 40%, 80%, 90%.

7. In an arithmetic test, a boy solved 80% of his problems correctly. What part did he solve correctly?

8. What part of the work in a test is correctly done when a mark of 90% is received?

III

[Without pencil.]

1. What per cent of a quantity is equal to $\frac{1}{8}$ of it?

2. Practice counting from $\frac{1}{8}$ to $\frac{8}{8}$, expressing each part as a per cent. Begin in this way: $\frac{1}{8} = 12\frac{1}{2}\%$; $\frac{2}{8}$, or $\frac{1}{4}$, $= 25\%$.

3. Learn these equivalents:

$\frac{1}{8} = 12\frac{1}{2}\%$. $\frac{3}{8} = 37\frac{1}{2}\%$. $\frac{5}{8} = 62\frac{1}{2}\%$. $\frac{7}{8} = 87\frac{1}{2}\%$.

4. What per cent of a quantity is equal to $\frac{1}{3}$ of it? To $\frac{2}{3}$? To $\frac{1}{6}$?

5. Count from $\frac{1}{6}$ to $\frac{6}{6}$, expressing each part as a per cent.

6. Learn these equivalents:

$\frac{1}{3} = 33\frac{1}{3}\%$. $\frac{2}{3} = 66\frac{2}{3}\%$. $\frac{1}{6} = 16\frac{2}{3}\%$. $\frac{5}{6} = 83\frac{1}{3}\%$.

Use the following exercises daily until they are mastered:

7. Express as per cents:

$\frac{1}{2}$	$\frac{1}{10}$	$\frac{1}{6}$	$\frac{2}{8}$	$\frac{9}{10}$	$\frac{3}{5}$	$\frac{1}{20}$	$\frac{1}{11}$	$1\frac{1}{2}$
$\frac{1}{4}$	$\frac{1}{5}$	$\frac{8}{10}$	$\frac{3}{4}$	$\frac{3}{5}$	$\frac{7}{8}$	$\frac{1}{25}$	$\frac{1}{7}$	$1\frac{1}{4}$
$\frac{1}{8}$	$\frac{1}{8}$	$\frac{2}{5}$	$\frac{4}{5}$	$\frac{5}{8}$	$\frac{5}{6}$	$\frac{1}{50}$	$\frac{1}{9}$	$1\frac{1}{5}$

8. Express as fractions:

50%	25%	$33\frac{1}{3}\%$	$66\frac{2}{3}\%$	$83\frac{1}{3}\%$	$11\frac{1}{9}\%$	$14\frac{2}{7}\%$
20%	80%	$12\frac{1}{2}\%$	70%	$37\frac{1}{2}\%$	$87\frac{1}{2}\%$	2%
40%	75%	10%	$16\frac{2}{3}\%$	$62\frac{1}{2}\%$	$9\frac{1}{11}\%$	150%
5%	4%	125%	$112\frac{1}{2}\%$	60%	$133\frac{1}{3}\%$	$187\frac{1}{2}\%$

46. The Fractional Part in Finding a Percentage

I

Out of his earnings amounting to $1750 a year, a man saves 20%. How much money does he save?

SOLUTION USING A COMMON FRACTION

$20\% = \frac{1}{5}$.

$\frac{1}{5} \times \$1750 = \$350$.

SOLUTION USING A DECIMAL

$20\% = .20$.

$\$1750 \times .20 = \$350.00$

[With pencil.]

In solving the following problems, change the per cents to common fractions wherever it is more convenient to do so:

1. Find 50% of $7890; $33\frac{1}{3}$% of $765; 75% of 3360; $66\frac{2}{3}$% of 972; 2% of 6792.

2. At a football game there were 336 persons present, 50% of whom were boys. How many boys were at the game?

3. A school athletic association had $67.60 in their treasury, 75% of which they spent for new suits for the baseball team. How much was spent for the suits?

4. A city set out 1575 new trees in one season. $33\frac{1}{3}$% of the number were maple trees, 20% were poplars. How many trees of each kind were set out?

5. There were 320 children who visited a park playground in one day. The attendance in the morning was 40% of the total attendance that day; in the afternoon, 45%; in the early evening, 15%. How many children were in the playground in the morning? In the afternoon? In the early evening?

*6. A city spends in one year $31,500 on its parks and playgrounds. $33\frac{1}{3}$% of this amount is spent on the playgrounds, which are visited during the year by 210,000 children. Find the average amount per child spent on the playgrounds.

II

[Without pencil.]

Find, as required, the percentage of each of the following numbers, thinking of each per cent as a common fraction:

1. 25% of: 440; 800; 1200; 2000.

2. 75% of: 400; 800; 1600; 4000; 8000.

3. $33\frac{1}{3}$% of: 600; 900; 330; 660; 6000.

4. $66\frac{2}{3}$% of: 600; 1200; 900; 660; 3000.

5. 20% of: 40; 500; 55; 150; 1500.

6. $12\frac{1}{2}$% of: 80; 800; 400; 2400.

7. $87\frac{1}{2}$% of: 80; 88; 800; 400; 4000.

[With pencil.]

Solve, using the most convenient method:

8. $33\frac{1}{3}$% of 1290 = ?

9. $66\frac{2}{3}$% of 1860 = ?

10. 12% of 864 = ?

11. 8% of 9760 = ?

12. 20% of 8640 = ?

13. $12\frac{1}{2}$% of 1760 = ?

14. 6% of 9782 = ?

15. 32% of 480 = ?

16. $37\frac{1}{2}$% of 784 = ?

17. $66\frac{2}{3}$% of 4500 = ?

18. 16% of 840 = ?

19. 75% of 1680 = ?

20. 25% of 4200 = ?

21. $16\frac{2}{3}$% of 1926 = ?

22. $87\frac{1}{2}$% of 6560 = ?

23. 150% of 7500 = ?

24. Increase 750, 10%; 1250, 20%; 3663, $66\frac{2}{3}$%.

47. Buying Goods at Marked-down Sales

When goods are sold at a given per cent less than the marked price, the amount taken off from the marked price is often spoken of as a **discount.** The per cent used is often called the **rate** of discount.

Winter coats are selling at a discount of 20%. How much must be paid for one marked $18.50?

The discount, 20% or $\frac{1}{5}$ of $18.50, is $3.70. The amount that must be paid for the coat is, therefore, $18.50 − $3.70, or $14.80.

[Without pencil.]

After Christmas, the following goods were marked down. Find at what price each was selling:

1. A book marked 75¢; discount, $33\frac{1}{3}$%.

2. A game marked 60¢; discount, 25%.

3. A fountain pen marked $1.20; discount, 10%.

4. A pocket book marked $1.25; discount, 20%.

5. When writing paper is marked 30¢ a box, how much must be paid for 3 boxes bought at a discount of $33\frac{1}{3}$%?

6. A handbag marked $4.00 sells at a discount of 25%; a travel case marked $1.50, at a discount of 20%. How much must be paid for the two articles?

7. Find the total amount that must be paid for a manicure set marked $1.20, a mirror marked $1.00, and a clothes brush marked $.80, if a discount of 10% is made on the bill.

[With pencil.]

8. Find how much more must be paid for a suitcase marked $5.00 than for one marked $3.00, if both are selling at a discount of 10%.

9. During a furniture sale, a writing desk marked $25.75 is offered for sale at a discount of 20%. How much must be paid for it?

10. A bedstead marked $32.00 is to be bought at a discount of 20%; a bureau marked $25.00, at a discount of 10%; and a stand marked $14.00, at a discount of 25%. How much must be paid for the three pieces of furniture?

11. A bookcase marked $25.00 can be bought at a discount of 40%. If I save $1.25 a week, how many weeks will it take me to save money enough to buy the bookcase?

12. A Gloucester hammock marked $26.50 with a discount of 20% costs how much more than one offered for sale at $18.75 without a discount?

*13. With the help of advertisements cut from local papers, make and solve three problems of your own in buying goods at marked-down sales.

*14. Not all discount sales are honest. Merchants sometimes raise the price of goods that they may appear to give a discount. A trunk

is offered for sale by one merchant at $8.75. Another merchant buys trunks of the same kind for $7.00. He marks the trunk at a price 50% in advance of what he paid for it and then offers it for sale at a discount of 10%. How much more does this merchant charge than the one who offers it for sale for $8.75?

48. Selling Groceries

I

The merchants from whom we buy our groceries and other supplies buy in large quantities and sell in small quantities. These merchants are called **retail merchants.**

The merchants from whom the retail merchants buy their goods are called **wholesale merchants.**

1. Wholesale merchants often have their headquarters in such large cities as New York, Chicago, and St. Louis. Can you find reasons for this?

2. Name several retail merchants doing business in your locality.

3. Give the names of some well-known wholesale firms.

The price charged for goods sold in large quantities is called the **wholesale price.** The one charged for goods sold in small quantities is called the **retail price.**

4. Which is usually higher, the wholesale or the retail price of an article? Explain why there should be a difference.

After a retail grocer has deducted from the amount he receives for an article, first, the wholesale price, and then the expense of selling the article, the amount left is his **profit.**

A merchant sometimes sells articles for less than they cost him. In this case, the difference between the wholesale price plus the expense of selling the goods, and the selling price, is called a **loss.**[1]

[1] The per cent of profit or loss is sometimes reckoned on the cost and some-

II

[Use pencil only when needed]

1. A grocer buys peaches at $.60 a basket. His profit is $16\frac{2}{3}\%$ of this amount. This is how many cents profit on each basket?

2. The grocer's profit on canned goods is 10% of the amount he pays for them. Find his profit on a can of pears bought for 30¢. On 3 cans of corn, bought for 20¢ a can. On 2 cans of tomatoes bought for 10¢ a can.

3. The grocer sells certain brands of cookies and crackers at a gain of $12\frac{1}{2}\%$ of the wholesale price. At this rate, what is his profit on a pound of gingersnaps bought at wholesale for 16¢ a pound? On a box of fancy cookies bought at wholesale for 24¢ a box? On 12 pounds of crackers bought at wholesale for 8¢ a pound?

4. Raisins are bought for 20¢ a box, and sold at a loss of 20%. This is a loss of how much on each box? On each dozen boxes?

5. How much is lost on a box of berries bought for 20¢ and sold at a loss of 25%? On a basket of plums bought for 40¢ and sold at a loss of 10%? On 3 lb. of California grapes bought for 15¢ a pound and sold at a loss of 20%?

6. The grocer bought apples at wholesale for $4.00 a barrel. The freight charges and the expenses of selling the apples came to 75¢ a barrel. The grocer sold the apples for $5.25 a barrel. What was his profit in dollars and cents on each barrel? On 10 barrels?

7. The grocer sold a box of oranges for $6.40. Of this amount $62\frac{1}{2}\%$ went to pay the wholesale merchant, and 25% for expenses incurred by the grocer in selling the oranges. How much did the oranges cost at wholesale? How much did it cost the grocer to sell the oranges?

8. Find in dollars or cents the grocer's net profit on the box of oranges.

times on the selling price. The cost is used as the basis in the problems in this book, unless it is otherwise stated.

[With pencil.]

9. What is the grocer's profit on 12 barrels of flour bought at wholesale for $13.00 apiece and sold at retail at a profit of 10%?

10. The grocer bought cheese of a certain kind for 24¢ a pound, which he sold at a profit of $16\frac{2}{3}$%. Find his profit on 150 pounds.

11. A case of two dozen bottles of olive oil is bought for $3.60 and sold at a loss of $33\frac{1}{3}$%. Find the amount lost on each bottle.

12. Find how much more money the grocer made in selling at a profit of 10% 20 dozen cakes of soap bought at 5¢ a cake, than in selling at a profit of $12\frac{1}{2}$% 6 dozen cakes bought at 8¢ a cake.

13. The grocer sold 50 gallons of kerosene at 20¢ a gallon. Of the amount he received, he used 75% in paying the wholesale cost and 20% in paying the expenses he had incurred in selling the kerosene. How much did he pay for the kerosene at wholesale? How much did it cost him to sell the kerosene? What was his profit?

*14. Find the grocer's profit on $31\frac{1}{2}$ gallons of molasses sold at $1.10 a gallon. Of this amount, $66\frac{2}{3}$% was used in paying the wholesale cost of the molasses, and 20% for expenses incurred by the grocer in selling the molasses.

49. Money at Interest

1. A rowboat rents for 20¢ an hour. At this rate, how much must be paid for the use of the boat for 2 hours?

2. At $25 a month, how much must be paid for 3 months' rent for a house?

3. A man borrows $100 and pays the man from whom he borrows it 4% a year for the use of the money. How much must he pay for the use of the money if he keeps it 2 years?

Just as people pay for the use of a boat or a house at a given rate for a given length of time, they pay for the use of money. In the problem above, the sum paid for the use of the $100 for 1 year is 4% of $100, or $4. For 2 years, the amount paid is 2 times $4, or $8.

Money paid for the use of money is called **interest.**

The interest on the $100 in the problem above is $4 a year, or $8 for the 2 years.

The sum of money on which interest is paid is called the **principal**; the per cent paid is called the **rate**; the period of time, the **time.**

[Use pencil only when needed.]

4. A man borrows $800 with which to help pay for a home. He pays 5% interest. This amounts to how much for 1 year? For 3 years?

5. A farmer borrows $1000 with which to buy cattle. At 4%, how much interest must he pay for the use of this money for 1 year? For 6 months?

Find the interest:

6. At 4% on $200 for 2 years.
7. At 5% on $300 for 3 years.
8. At 3% on $400 for 6 months.
9. At 6% on $200 for 3 months.
10. At 4% on $300 for 1 year 6 months.
11. At 4% on $2000 for 2 years 3 months.

12. A bank pays 3 per cent interest on money deposited in it. If I deposit $300 and leave it to draw interest for 1 year, how much will be due me at the end of that time, including both the money deposited and the interest?

Find the amount that should be returned:

13. On a loan of $500 returned in 1 year with interest at 5%.
14. On a loan of $800 returned in 6 months with interest at 4%.
15. On a loan of $4000 returned in 3 months with interest at 5%.
16. On a loan of $1500 returned in 4 months with 6% interest.
17. On a loan of $2000 returned in 8 months with 5% interest.

50. Expressing a Comparison as Per Cent

I

[Without pencil.]

1. I have 20¢ and spend 10¢. What part of my money do I spend? What per cent?

2. $12 is what part of $36? What per cent?

3. Find what per cent 8 is of 16; 10 is of 40; 5 is of 25; 9 is of 27.

4. A merchant buys a pocket knife for 50¢, and sells it at a gain of 20¢. The gain is what part of the cost? What per cent?

20¢, the gain, = $\frac{20}{50}$, or $\frac{2}{5}$, of 50¢, the cost.

$\frac{2}{5}$ expressed as a per cent is —.

5. Imagine that you have the management of a store where athletic goods are sold, and that you buy a basket ball for $3.00, which you sell at a gain of $1.00. The gain would be what part of the cost? What per cent?

6. A golf club bought for $2.50 is sold at a gain of 50¢. This gain is what part of the cost? What per cent?

7. In one department, you have skates for sale. Roller skates bought for $1.20 a pair are sold at a gain of 40¢. Ice skates bought for $2.40 a pair are sold at a gain of 60¢. Which kind of skates brings you the larger per cent of profit?

8. To get rid of an over-stock of tennis rackets, you sell rackets, which cost you $2.00, at a loss of 50¢. The loss is what part of the cost? What per cent?

9. Find the per cent lost on a racket that cost $3.00, which is sold at a loss of 30¢.

10. You buy a toboggan at wholesale for $7.00 and sell it for $10.00. The freight charges and other expenses of handling the toboggan come to $1.00. How many dollars' profit do you make on the toboggan?

11. The net profit on the toboggan is what per cent of the cost at wholesale? Of the retail selling price?

12. A football bought at wholesale for \$4.00 is sold at retail for \$5.00. After allowing 50¢ as the expense of handling the football, how much profit is left? This profit is what per cent of the cost at wholesale? Of the retail selling price?

II

A pair of snowshoes bought for \$6.50 is sold at a gain of \$1.40. The gain is what per cent of the cost?

The gain, \$1.40, $= \frac{140}{650}$ of the cost.

$\frac{140}{650} = 140 \div 650.$

$$
\begin{array}{r|l}
 & .21\frac{7}{13} \\
650 & 140.0 \\
 & 130\ 0 \\
\hline
 & 1000 \\
 & 650 \\
\hline
 & \frac{350}{650} = \frac{7}{13}
\end{array}
$$

$.21\frac{7}{13} = 21\frac{7}{13}\%.$

The gain is $21\frac{7}{13}\%$ of the cost.

Notice that, in finding what per cent one number is of another, the comparison is first expressed as a common fraction and then reduced to a decimal in hundredths. The number of hundredths found is the required per cent.

[With pencil.]

1. A sweater bought for \$6.00 sells at a gain of \$.75. The gain is what part of the cost? What per cent?

2. Tennis shoes bought for \$2.50 sell at a loss of 35¢. The loss is what part of the cost? What per cent?

3. A football suit bought at wholesale for \$10.00 is sold for \$15.00. After allowing \$2.75 as the cost of handling the suit, how much profit is left? The profit is what per cent of the cost at wholesale? Of the retail selling price?

4. The cost of a baseball suit at wholesale is $5.00; the cost of selling the suit, $1.50; the retail price, $7.50. The net profit on this suit is what per cent of the cost at wholesale? Of the retail selling price?

*5. A camping outfit is bought at wholesale for $15.00 and sold for $22.50. After allowing 20% of the retail price as the cost of selling the goods, the net profit is what per cent of the cost at wholesale?

III

[Without pencil.]

Express as a per cent the ratio of:

1. 20 to 60.	6. 30 to 40.	11. 40 to 50.
2. 25 to 50.	7. 50 to 75.	12. 24 to 36.
3. 5 to 25.	8. 27 to 36.	13. 50 to 60.
4. 8 to 32.	9. 70 to 100.	14. 35 to 40.
5. 12 to 18.	10. 10 to 25.	15. 75 to 50.

[With pencil.]

16. 250 to 750.	19. 144 to 288.	22. 640 to 720.
17. 650 to 1000.	20. 360 to 600.	23. 560 to 640.
18. 250 to 625.	21. 375 to 875.	24. 125 to 625.

The net profit on each of these articles was what per cent of the cost?

25. Cost of desk $13.50; net profit, $2.25.

26. Cost of easy chair, $12.60; net profit, $3.15.

27. Cost of stand, $7.20; net profit $1.44.

51. Finding the Number upon which a Percentage is Based

I

[Without pencil.]

1. 50%, or ½, of the distance between two places is 32 miles. What is the entire distance between the two places?

2. I spent 25%, or $\frac{1}{4}$, of the money in my pocket book. How much money did it contain if the amount spent was $1.20?

3. One fifth, or 20%, of a number is 8. What is 100%, or the whole number?

Find 100%, or the whole number:

4. When 10%, or —, of the number is 7.

5. When 25%, or —, of the number is 9.

6. When $12\frac{1}{2}$%, or —, of the number is 5.

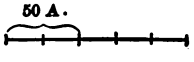
7. When $16\frac{2}{3}$%, or —, of the number is 10.

8. When $33\frac{1}{3}$%, or —, of the number is 200.

9. When 50%, or —, of the number is 350.

II

A farm contains 50 acres of woodland. How many acres are there in the farm if the number of acres of woodland is 40% of the entire number?



40% = $\frac{2}{5}$.
$\frac{2}{5}$ of the farm = 50 A.
$\frac{1}{5}$ " " " = $\frac{1}{2}$ of 50 A., or 25 A.
$\frac{5}{5}$ " " " = 5 × 25 A., or 125 A.

To solve this problem by a short cut, first compare 100% of the number of acres in the farm with 40%. 100% = $\frac{5}{2}$ of 40%. The number of acres in the farm is, therefore, $\frac{5}{2}$ × 50 A., or 125 A.

[Use pencil for drawings only.]

1. The height of a school building is $66\frac{2}{3}$% of the height of a flagpole that stands beside it. The building is 40 feet high. What is the height of the flagpole? (Make a drawing.)

2. Seventy-five per cent of the distance between two places is 300 miles. What is the entire distance between them? (Make a drawing.)

3. Sixty per cent of the weight of a box to be sent by freight is 15 pounds. What is the entire weight? (Make a drawing.)

4. I spent $37\frac{1}{2}\%$ of my money for a bicycle costing $30. How much money did I have?

5. Thirty per cent of John's money is in a savings bank. How much money has he if the amount in the bank is $60?

Find the number of which:

6. 40% is 20.	11. $66\frac{2}{3}\%$ is 24.	16. 200% is 42.
7. 75% is 600.	12. $37\frac{1}{2}\%$ is 27.	17. 500% is 25.
8. 60% is 30.	13. $62\frac{1}{2}\%$ is 35.	18. 300% is 270.
9. $16\frac{2}{3}\%$ is 8.	14. $87\frac{1}{2}\%$ is 21.	*19. 150% is 60.
10. $83\frac{1}{3}\%$ is 300.	15. 80% is 40.	*20. 125% is 800.

III

Frank sold 24 tickets for a school entertainment. How many tickets were sold in all if this number was 12% of the total?

12% of the total number = 24 tickets.
1% " " " " = $\frac{1}{12}$ of 24 tickets, or 2 tickets.
100% " " " " = 100 × 2 tickets, or 200 tickets.
The total number sold = 200 tickets.

In Exercise II the problems were solved by expressing each per cent in its fractional form. In the problem above, it is more convenient to keep the rate in its per cent form, finding first the value of 1 per cent and then of 100 per cent.

[Without pencil.]

Solve by the most convenient method:

1. John is saving money with which to go through college. At one time he put $18 in the bank. How much did he then have in the bank if this sum was 6% of his total savings?

2. Margaret is earning money to help buy a piano. She has earned $12, or 3% of the amount necessary. How much is the piano to cost?

3. A school has earned $75 toward the cost of equipping a playground. This is $37\frac{1}{2}\%$ of the total amount required. Find how much the equipment is to cost.

4. A family has paid $2000, or $66\frac{2}{3}\%$, on the cost of a house. Find the total cost.

5. An automobile was sold second hand at a loss of $1200, or 40% of the amount paid for it. How much was paid for it?

Find the number of which:

6. 4% is 12.	9. 7% is 42.	12. 75% is 30.	15. 11% is 44.
7. 3% is 15.	10. 20% is 10.	13. $66\frac{2}{3}\%$ is 12.	16. 40% is 20.
8. $12\frac{1}{2}\%$ is 6.	11. 6% is 18.	14. 8% is 72.	17. $37\frac{1}{2}\%$ is 60.

[With pencil.]

18. The pupils in a sixth grade have earned $75 toward the cost of a Victrola. This is 60% of the amount to be paid for it. How much is the Victrola to cost?

19. A city library buys in one year 2484 new books. This is 3% of the total number of books belonging to the library. Find the number of books belonging.

20. In the children's department, 936 books were rebound in one year. How many books were there in the children's department if the number rebound was $12\frac{1}{2}\%$ of the total number?

21. A family spends 15% of their income per year for rent. The amount paid per month is $22.50. Find how much they receive as their yearly income.

*22. Mr. Brown sells a house for $3360 at a gain of 12% of the amount he paid for it. How much did he pay for the house?

*23. A motorcycle is sold at second hand for $157.50 at a loss of $37\frac{1}{2}\%$. Find how much was paid for the motor cycle when it was new.

Find the number of which:

24. 3% is 279.
25. 5% is 625.
26. 4% is 372.
27. 6% is 564.
28. 8% is 7520.
29. $12\frac{1}{2}$% is 672.
30. $16\frac{2}{3}$% is 960.
31. 25% is 3000.
32. $33\frac{1}{3}$% is 330.
33. 20% is 3960.
34. 75% is 1500.
35. $62\frac{1}{2}$% is 590.
36. 40% is 2500.
37. $37\frac{1}{2}$% is 2940
38. $83\frac{1}{3}$% is 2250.

*39. Find the number which, if increased $87\frac{1}{2}$%, equals 4500.

*40. Find the number which, if decreased 40%, equals 5070.

52. Test and Graded Practice

With the help of these exercises find out and overcome your difficulties in using per cents. If you fail to get the correct answer to a problem in the test, practice solving the problems in the set having the same letter.

Test No. 16. [With pencil.]

A. 6% of 350 = ?
B. $66\frac{2}{3}$% of 972 = ?
C. Increase 840, 4%.
D. Increase 720, $37\frac{1}{2}$%.
E. Decrease 540, 3%.
F. Decrease 968, 25%.
G. 450 = ? % of 600?
H. 84 = ? % of 1400?
I. 36 = 2% of —.
J. 240 = 40% of —.

PRACTICE

[Use pencil only when needed.]

A. Find:

1. 3% of 200.
2. 2% of 425.
3. 6% of 175.
4. 12% of 42.8.

B. Find:

5. $33\frac{1}{3}$% of 960.
6. $16\frac{2}{3}$% of 858.
7. 20% of 2575.
8. $12\frac{1}{2}$% of 1234.
9. $66\frac{2}{3}$% of 942.
10. $37\frac{1}{2}$% of 720.
11. 75% of 428.
12. $83\frac{1}{3}$% of 625.
13. $87\frac{1}{2}$ % of 584.

C. Increase:

14. 400, 2%.
15. 540, 3%.
16. 4120, 4%.
17. 6750, 6%.
18. 9024, 5%.

D. Increase:

19. 800, 50%.
20. 429, $33\frac{1}{3}$%.
21. 640, $12\frac{1}{2}$%.
22. 375, 60%.
23. 2496, $87\frac{1}{2}$%.

E. Decrease:

24. 600, 5%.
25. 720, 3%.
26. 845, 6%.
27. 2475, 4%.
28. 6475, 8%.

F. Decrease:

29. 5000, 10%.
30. 1200, $16\frac{2}{3}$%.
31. 250, 20%.
32. 8720, 25%.

G. Complete:

33. 360 = —% of 720.
34. 288 = —% of 1728.
35. 25 = —% of 625.
36. 612 = —% of 816.

H. Complete:

37. 8 = —% of 200.
38. 24 = —% of 600.
39. 57 = —% of 950.

I. Complete:

40. 5 = 1% of —.
41. 14 = 2% of —.
42. 21 = 7% of —.
43. 18 = 3% of —.
44. 48 = 12% of —.
45. 258 = 4% of —.

J. Complete:

46. 8 = 10% of —.
47. 70 = 20% of —.
48. 300 = $16\frac{2}{3}$% of —.
49. 80 = $12\frac{1}{2}$% of —.
50. 45 = $37\frac{1}{2}$% of —.
51. 240 = 75% of —.

53. School Records

[Without pencil.]

1. A class has a membership of 40 children. What is the per cent of attendance when all are present? When 36 are present?

2. In this class, 60% are boys. How many boys belong to the class? How many girls?

3. The class has its membership increased 10 per cent. What is its new membership?

4. In a primary school there are 30 children in the first grade.

This is 20% of the entire number belonging to the school. Find the number belonging.

5. On a stormy day in winter, out of a membership of 240 pupils, $12\frac{1}{2}$% are absent. How many children are absent? How many are present?

6. A school is in session 5 hours a day. Out of this time, 30 minutes are taken for recesses and recreation. What per cent of the time is used for class work and study?

7. A test in arithmetic contains 5 problems to be solved. What per cent of the whole number is each problem? What per cent of credit should be given for 3 problems correctly solved? For 4 problems?

8. Find the per cent of credit that should be given when 9 problems out of 10 are correctly solved. When 7 out of 8 are correctly solved.

9. In a test containing 10 questions, a pupil gets a mark of 80%. How many of the questions were answered correctly?

10. How many questions are correctly answered in a test containing 12 questions when the mark given is $83\frac{1}{3}$%?

[With pencil.]

11. A certain city has 3420 pupils enrolled in its schools. 20% of this number are in its high school. Find the membership of the high school.

12. It costs this city $72.24 a year for each pupil in the high school and $66\frac{2}{3}$% of this amount for each pupil below the high school. How much does it cost the city for each pupil below the high school?

13. Find the total cost to the city of the high school for a year. Of the schools below the high school. (See problems 11 and 12.)

14. In another city the cost per pupil in the high school is $50.00; in the grammar school, $33.50. The cost per pupil in the grammar school is what per cent of that per pupil in the high school?

*15. In a certain school, the cost of heating and caring for the building is $5.72 per pupil. This is $16\frac{2}{3}\%$ of the total amount spent on each pupil. The school has a membership of 308 pupils. Find the total amount spent on the school.

54. Problem Test

[Without pencil.]

1. A boy earns $8.00, 75% of which he puts into a savings bank. Find the amount put into the bank.

2. A bank pays 4% interest. How much interest is due on $300 left to draw interest for 6 months?

3. I borrow a sum of money; 4% of the amount is $8. Find the total amount borrowed.

4. A boy buys a pair of skates for $1.50. Later he sells them at second hand for $1.00. What per cent of the cost does he lose?

5. A book that cost 60¢ is sold at a gain of 30¢. The gain was what per cent of the cost?

6. Shoes are selling at a discount of 20%. At this rate, how much must be paid for a pair marked $10.00?

[With pencil.]

7. A man earning $3600 a year spends 15% of his money for rent, and 10% for clothes for himself and his family. How much of his income is left after taking out these two expenses?

8. A kitchen stove marked $45.60 is sold at a discount of 20%. Find the price at which it is sold.

9. I leave $900 to draw interest in a bank for 4 months at 3%. How much money can I draw out at the end of the four months?

10. Three per cent of a boy's savings amounts to $9.78. Find the total amount.

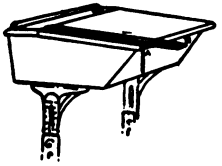
11. A house was bought for $2500 and sold for $2200. The loss was what per cent of the cost?

CHAPTER VII. MEASUREMENTS

55. Linear Measure

[Use pencil only when needed.]

1. Estimate in inches the width, then the length, of the top of your desk.



2. Compare your estimate with the exact measurements.

Notice in the drawing how the pencil is placed in relation to the ruler, so as to include in the measurements the beveled edge of the desk.

3. What is the length of your desk in feet and inches? What is its width in feet and inches?

4. Estimate in feet the width, then the length, of your schoolroom. Write your estimates in a table like the one below. Complete your table by writing in, first, the actual measurements of the room, and next, the number of feet and inches by which your estimates differ from the correct measurements.

SCHOOLROOM MEASUREMENTS

	Estimate	Measurement	Correction
Width			
Length			

5. Estimate the dimensions of one of the blackboards in your schoolroom. Also of one of the doors and of one of the windows. (Make a table for each.)

6. With a yard stick draw a line 1 yard long.

7. Mark off on your schoolroom floor a distance 1 rod long.

8. Find the length of your schoolroom in yards. In rods and feet.

9. Write from memory the table of linear measure, and then compare your table with the one at the back of the book.

10. The top of a school desk is 16 in. wide and 24 in. long. What are its dimensions in feet?

11. A schoolroom is 24 ft. by 28 ft. What is its width in yards? What is its length in yards?

12. A corridor is 2 rd. 10 ft. long. What is its length in feet?

Reduce:

13. $1\frac{1}{2}$ ft. to in.	18. 1 yd. 8 in. to in.	23. 45 in. to yd.
14. $1\frac{1}{4}$ yd. " "	19. 1 yd. 2 ft. " "	24. 14 ft. " "
15. .5 ft. " "	20. 54 in. to ft.	25. 2 rd. " "
16. .25 yd. " "	21. $2\frac{2}{3}$ yd. " "	26. 1 rd. $1\frac{1}{2}$ yd. to yd.
17. 3 ft. 7 in. to in.	22. 2 rd. " "	27. 1 rd. 10 ft. to ft.

[With pencil.]

28. 1000 ft. to yd.	31. 12 rd. to ft.	34. $\frac{1}{4}$ mi. to yd.
29. $\frac{1}{2}$ mi. to ft.	32. 100 rd. to yd.	35. 500 rd. to mi.
30. 2.5 mi. to rd.	33. 100 ft. to rd.	36. 10,000 ft. to mi.

56. Computing Lengths and Distances

I

Two boards are placed end to end. One board is 12 ft. 7 in. long; the other, 11 ft. 9 in. long. What is their combined length?

12 ft. 7 in. + 11 ft. 9 in. = ?

12 ft. 7 in.	9 in. + 7 in. = 16 in., or 1 ft. 4 in.
11 " 9 "	1 ft. + 11 ft. + 12 ft. = 24 ft.
24 ft. 4 in.	The length of the boards is 24 ft. 4 in.

[Use pencil only when needed.]

1. What is the sum of 18 ft. 10 in. and 12 ft. 11 in.? Of 9 ft. 5 in., 16 ft. 10 in., and 8 ft. 3 in.?

2. Add: 4 yd. 7 in. to 9 yd. 32 in.; 1 rd. 12 ft. to 2 rd. 10 ft.

3. A triangular garden measures 13 yd. 18 in. on one side, 10 yd. 12 in. on another side, and 12 yd. 16 in. on the third side. What is the distance around the garden?

4. What length of fence is required for two sides of a building lot if one side measures 30 yd. 2 ft., and the other, 15 yd. 2½ ft.?

5. 9 ft. 4 in. + 7 ft. 7 in. + 8 ft. 9 in. = ?

6. 8 yd. 27 in. + 4 yd. 24 in. + 9 yd. 11 in. = ?

7. 4 rd. 12 ft. + 10 rd. 9 ft. = ?

8. 5 rd. 7 ft. + 4 rd. 6 ft. + 7 rd. 11 ft. = ?

II

How much longer is a fish pole 9 ft. 6 in. long than one 7 ft. 3 in. long? Than one 6 ft. 8 in. long?

9 ft. 6 in. − 7 ft. 3 in. = ?	9 ft. 6 in. − 6 ft. 8 in. = ?
9 ft. 6 in. 7 " 3 " 2 ft. 3 in.	9 ft. 6 in. 6 " 8 " 2 ft. 10 in.
The difference = 2 ft. 3 in.	The difference = 2 ft. 10 in.

1. Explain how the first of these answers was found.

In solving the second problem, since the 8 in. could not be subtracted from 6 in., 1 ft. was taken from the 9 ft. in the minuend, called 12 in., and added to the 6 in. The problem then stood: 8 ft. 18 in. − 6 ft. 8 in. = ?

[Use pencil only when needed.]

2. Find the difference between 14 ft. 9 in. and 12 ft. 7 in. Between 20 ft. 4 in. and 14 ft. 10 in.

3. Subtract 4 yd. 12 in. from 10 yd. 17 in.; 12 yd. 24 in. from 40 yd. 7 in.; 4 rd. 5 ft. from 9 rd. 12 ft.

4. Grammar-school boys have made a record of 4 ft. $10\frac{1}{4}$ in. in a running high jump; high-school boys have made a record of 5 ft. 9 in. Find the difference in the records.

5. The world's record for a running high jump was, in a recent year, 6 ft. $5\frac{5}{8}$ in. This was how much higher than the high-school record given in problem 4? Than the grammar-school record?

6. The world's record for a running broad jump was, in a recent year, 24 ft. $7\frac{1}{4}$ in.; the high-school record, 21 ft. 2 in.; the grammar-school record, 16 ft. 11 in. Make and solve a problem comparing the grammar-school record with the high-school record. With the world's record.

7. 24 ft. 11 in. − 9 ft. 7 in. = ?

8. 44 ft. 5 in. − 22 ft. 9 in. = ?

9. 12 yd. 18 in. − 7 yd. 11 in. = ?

10. 24 yd. 14 in. − 9 yd. 27 in. = ?

11. 42 rd. 8 ft. − 15 rd. 6 ft. = ?

III

A square plot of ground measures 5 yd. 14 in. on a side. What is the distance around the plot?

5 yd. 14 in. × 4 = ?

5 yd. 14 in.	14 in. × 4 = 56 in. = 1 yd. 20 in.
4	5 yd. × 4 = 20 yd. 20 yd. + 1 yd. = 21 yd.
21 yd. 20 in.	The distance around the plot is 21 yd. 20 in.

[Use pencil only when needed.]

1. Multiply 8 ft. 7 in. by 8; 3 yd. 20 in. by 2; 2 yd. 2 ft. 5 in. by 4; 4 rd. 6 ft. by 3.

2. Find the perimeter of a square measuring 6 ft. 8 in. on a side. Of a triangle measuring 8 yd. 17 in. on a side.

3. A rectangular field is 40 rd. 12 ft. in length and 30 rd. 10 ft. in width. What is the distance around the field?

4. The basin of a fountain is a regular hexagon (a figure having six equal sides) measuring 2 ft. 9 in. on a side. Make a drawing of the basin and then find its perimeter.

Multiply:

5. 2 yd. 19 in. by 4.
6. 12 ft. 9 in. by 6.
7. 24 ft. 5 in. by 24.
8. 4 rd. 3 yd. by 12.
9. 14 rd. 8 ft. by 4.
*10. 12 rd. $4\frac{1}{2}$ ft. by 33.

IV

The perimeter of a square is 13 ft. 8 in. What is the length of each side?

13 ft. 8 in. ÷ 4 = ?

$$\begin{array}{r} 3 \text{ ft. } 5 \text{ in.} \\ 4\overline{)13 \text{ ft. } 8 \text{ in.}} \end{array}$$

13 ft. ÷ 4 = 3 ft. with a remainder of 1 ft.
The remainder 1 ft. is reduced to inches and added to the 8 in.
1 ft. = 12 in.
12 in. + 8 in. = 20 in.
20 in. ÷ 4 = 5 in.

The length of each side of the square is 3 ft. 5 in.

[Use pencil only when needed.]

1. Divide 7 ft. 3 in. by 3; 11 ft. 8 in. by 5; 9 yd. 6 in. by 4; 3 rd. $1\frac{1}{2}$ ft. by 2.

2. A board 10 ft. 3 in. long is to be divided into 3 equal lengths. How long will each piece be?

3. Find the length of each piece when a board 11 ft. 4 in. is cut into 2 equal lengths. When a board 14 ft. 8 in. long is cut into 4 equal lengths.

4. A school playground is 95 yd. 2 ft. long. What is $\frac{1}{2}$ its length?

*5. The perimeter of a triangular field with sides of equal length is 40 rods. Find the length of each side in rods and feet.

57. Measuring Surfaces

I

In measuring surfaces, the square units commonly used are the square inch, the square foot, the square yard, the square rod, the acre, and the square mile.

1. Which of the units would you be likely to use in measuring the surface of a small sheet of paper? In measuring the area of a building lot? Of a field? Of a farm?

2. Which unit is used for the area of a continent or an ocean?

3. Draw on a blackboard a square inch, a square foot, and a square yard. Pace a square rod.

4. Give from memory the table of square measure, then compare your table with the one at the back of the book.

II

(1) A building lot that covers 40 sq. rd. contains how many square feet?

(2) A field offered for sale covers 7260 sq. yd. The field contains how many acres?

(1)	(2)
40 sq. rd. = $30\frac{1}{4}$ sq. yd. × 40, or 1210 sq. yd.	The number of sq. rd. in 7260 sq. yd. = 7260 sq. yd. ÷ $30\frac{1}{4}$ sq. yd., or 240.
1210 sq. yd. = 9 sq. ft. × 1210, or 10,890 sq. ft.	The number of A. in 240 sq. rd. = 240 sq. rd. ÷ 160 sq. rd., or 1.5.
The lot contains 10,890 sq. ft.	The field contains 1.5 A.

[With pencil.]

1. A playground contains 2 acres. How can the number of square rods in it be found? How many are there?

2. One acre equals how many square yards? How many square feet?

3. Reduce: 100 sq. rd. to square yards; 80 sq. rd. to square feet; 1.25 A. to square yards.

4. An athletic field containing 1280 sq. rd. covers how many acres?

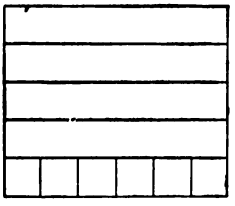
5. Reduce: 1000 sq. ft. to square yards; 2178 sq. ft. to square rods; 14,520 sq. yd. to acres.

*6. Find the value of 174,240 sq. ft. of land at $75 an acre.

*7. An acre of land can be bought in one locality in a city for $4000; in another locality, at 10¢ a square foot. Find the difference in the prices.

III

[Use pencil only when needed.]



1. With the help of this drawing, explain how to find the number of square inches in a sheet of paper 5 in. wide and 6 in. long.

2. A rug is 3 yd. wide and 4 yd. long. How is its area found?

3. Give a rule for finding the number of square units in any surface.

Find the area:

4. Of a sheet of paper 8 in. wide and 10 in. long.

5. Of a pane of glass 10 in. wide and 14 in. long.

6. Of a floor 12 ft. wide and 20 ft. long.

7. Of a garden 8 yd. wide and 12½ yd. long.

8. Of a field 20 rd. wide and 30 rd. long.

9. Estimate the number of square feet in one side of your schoolroom door. Measure the door, find the area, and then compare your estimate with the actual area.

10. Copy and complete this table, using one of the blackboards and the floor of your schoolroom as a basis for the measurements:

AREAS IN SQUARE FEET

	Estimate of area	Width	Length	Area	Correction
Blackboard					
Schoolroom Floor					

11. A schoolroom 24 ft. wide and 30 ft. long contains how many square feet?

12. A gymnasium floor 40 ft. wide and 70 ft. long is to be laid. Find the cost at 18¢ a square foot.

13. A sidewalk 6 ft. wide and 60 ft. long is to be built of concrete. How many square feet will it cover? How many square yards?

14. Find the cost of the sidewalk at $1.25 a square yard.

15. Find the cost of a sidewalk 5 ft. wide and 90 ft. long at $1.50 a square yard.

16. Imagine that you are a dealer in linoleums. Find how much you must charge, at $1.20 a square yard, for a piece of linoleum 6 ft. wide and 12 ft. long.

17. At 90¢ a square yard, how much must you charge for linoleum to cover a kitchen floor 12 ft. by 15 ft., if there is no waste in cutting? How much would you charge for an order of the same to cover a floor 9 ft. by $14\frac{3}{4}$ ft.?

18. You advertise your goods for sale with a 10% discount. At this rate, how much must you charge for a piece of linoleum 9 ft. wide and 16 ft. long, marked to sell at $1.50 a square yard?

19. A real estate dealer buys a field 16 rd. wide and 30 rd. long. How many square rods does it contain? How many acres?

*20. The dealer advertises a building lot with a frontage of 50 ft. and a depth of 120 ft. for sale at $12 a front foot. This is how much a square foot?

*21. Find the value of land in your neighborhood. With this in mind, make three problems on the value of building lots.

58. The Area and One Dimension Given, to Find the Other Dimension

[Use pencil only when needed.]

What is the length of a sheet of paper containing 32 sq. in., if its width is 4 in.?

Since the width of the rectangle is 4 in., there must be 4 sq. in. in each row of its width. In the whole rectangle, there are as many rows of 4 sq. in. as 4 sq. in. are contained in 32 sq. in. 32 sq. in. ÷ 4 sq. in. = 8. There are 8 rows. A rectangle containing 8 rows of 4 sq. in. must be 8 in. long and 4 in. wide. The length of the paper is, therefore, 8 in.

To find one side of a rectangle when the other side and the area are given, divide the number of square units in the area by the number in the one side given.

[Use pencil only when needed.]

1. How long is a sheet of paper containing 12 sq. in., if it is 3 in. wide? Explain.

Find the length:

2. Of a room 10 ft. wide containing 120 sq. ft.
3. Of a porch floor 12 ft. wide containing 240 sq. ft.
4. Of a walk 3 ft. wide containing 180 sq. ft.
5. Of a gymnasium 50 ft. wide containing 5000 sq. ft.

Find the width:

6. Of a rug 4 yd. long containing 14 sq. yd.

7. Of a window shade 8 ft. long containing 26 sq. ft.

8. Of a bedroom floor 15 ft. long containing 180 sq. ft.

9. A playground 120 ft. wide contains 26,400 sq. ft. Find its length.

10. A building lot 120 ft. deep contains 5400 sq. ft. What is its frontage?

11. I have a garden 42 ft. wide which contains 3696 sq. ft. How can I find its perimeter? What is the perimeter?

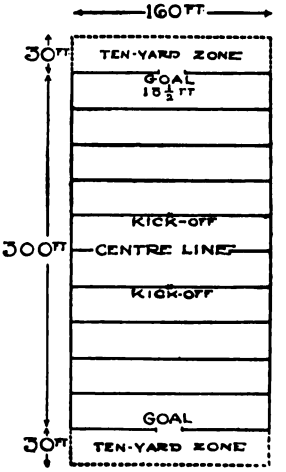
12. Find the perimeter of a lot 24 ft. wide containing 4800 sq. ft.

*13. A field 20 rods wide containing 10 acres is to be enclosed with fencing. Find the number of yards of fencing required.

59. An Athletic Field

I

[Use pencil only when needed.]



1. Football grounds are marked out to resemble a gridiron. With the help of this drawing, find the distance in yards from one goal to the other. From the center line to either goal. From the kick-off to the nearest goal.

2. What is the entire length of the gridiron in feet if the two ten-yard zones are included? What is its entire length in yards?

3. What is the width of the gridiron in yards?

4. A football field is to be laid out with a strip of land 25 ft. wide extending be-

yond each of the four sides of the gridiron. How wide a field is required? How long a field?

5. Find the area of the gridiron. Of the field.

6. The field is to be bought at 1¢ a square foot. How much will it cost?

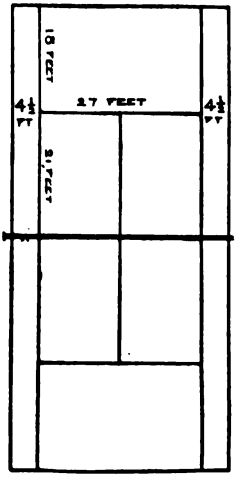
7. A fence is to be built around the field. How many feet of fencing are required?

8. A plan of the grounds is to be drawn to a scale of $\frac{1}{8}$ of an inch to 10 feet. How wide and how long a rectangle is required for the gridiron? For the field?

*9. Draw a plan of the football field described above, using the scale given in problem 8.

II

[Use pencil only when needed.]



1. A tennis court is to be laid out. Find the length and width of the ground required for the court. (See drawing for measurements.)

2. A strip of land 8 ft. wide is to be allowed on each side of the court, and one 15 ft. wide at each end. What are the dimensions of the land required?

3. Two back-stops each 12 ft. high and 46 ft. long are to be made of chicken wire. Find the cost at 1½¢ a square foot.

*4. A tennis court is to be placed in the middle of a strip of land 50 ft. wide and 100 ft. long. What will be the width of the margin of land on each side of the court?

*5. A baseball diamond 90 ft. on a side is to be marked out in the middle of a field 200 ft. wide and 300 ft. long. Make a rough sketch

of the field and then draw a careful plan to a scale of $\frac{1}{8}$ of an inch to 10 ft.

60. A Swimming Pool

[Use pencil only when needed.]

1. A swimming tank is 30 ft. long and 20 ft. wide. How many yards does a boy or girl swim in going its length 6 times? In swimming across it 8 times?

2. How many times is it necessary to swim the length of the tank to make a record of 100 yards? To make a record of $\frac{1}{4}$ of a mile?

3. What is the perimeter of the tank in feet? In yards?

4. What is the area of the surface of the water in square feet? In square yards?

5. The bottom of the tank is a rectangle 20 ft. wide and 30.27 ft. long. The area of the bottom is how much greater than that of the surface of the water?

*6. Use a scale of $\frac{3}{16}$ of an inch to a foot, and draw a rectangle to represent the top surface of the tank.

61. Measuring Contents

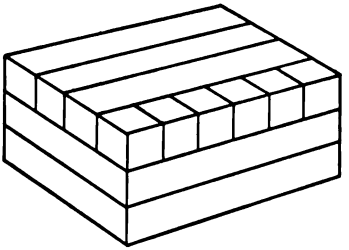
I

[Use pencil only when needed.]

1. In measuring the contents of a box, a grain bin, a wagon, or a freight car, cubic units are sometimes used. A cubic inch may be thought of as a rectangular figure one inch in height, one inch in depth, and one inch in width. What is meant by a cubic foot? A cubic yard?

2. The block or prism pictured here is bounded by six rectangular surfaces. Find why it is called a rectangular prism.

3. Give examples of other rectangular prisms.



4. A rectangular block or prism 5 inches long, 4 inches wide, and 3 inches high contains how many cubic inches?

Since the length is 5 inches, each long row in each layer contains 5 cubic inches.

Since the width is 4 inches, each layer in the cube contains 4 rows of 5 cubic inches each.

Since the height is 3 inches, the entire cube contains 3 layers of cubic inches.

The cube, therefore, contains 5 cu. in. × 4 × 3, or 60 cu. in.

5. Explain how to find the number of cubic units in a rectangular prism.

6. How many inch cubes can be fitted into a box measuring on the inside 3 inches in length, 2 inches in width, and 1 inch in depth?

Find the number of cubic inches that can be fitted into boxes with the following inside dimensions:

7. Length, 4 in.; width, 2 in.; depth, 2 in.

8. Length, 5 in.; width, 3 in.; depth, 2 in.

9. Length, 6 in.; width, 2 in.; depth, 3 in.

Find the number of cubic feet:

10. Of water in a swimming tank 40 ft. long, 30 ft. wide, with an average depth of 10 ft.

11. Of oats in a bin 12 ft. long, 8 ft. wide, filled to a depth of $4\frac{1}{2}$ ft.

12. Of wheat in a car 30 ft. long, 8 ft. 6 in. wide, filled to a depth of 4 ft.

13. Of loam in a wagon 3 ft. wide, 6 ft. long, filled to an even depth of $2\frac{1}{2}$ ft.

14. Of air in a schoolroom 24 feet wide, 30 feet long, and 12 feet high.

*15. Of air per pupil in your own schoolroom.

II

[Use pencil only when needed.]

1. How many cubic inches are there in a 12-inch cube? In a cubic foot?

2. How many cubic feet are there in a 3-foot cube? In a cubic yard?

TABLE OF CUBIC MEASURE

1728 cubic inches (cu. in.)	= 1 cubic foot (cu. ft.)
27 cubic feet	= 1 cubic yard (cu. yd.)

3. Reduce to cubic inches: $\frac{1}{4}$ cu. ft.; 1.75 cu. ft.

4. Reduce to cubic feet: $1\frac{1}{2}$ cu. yd.; 3456 cu. in.

5. Reduce to cubic yards: 108 cu. ft.; 1000 cu. ft.

6. A tank filled with $\frac{1}{2}$ a cubic foot of water contains how many cubic inches of water?

7. To improve the drainage, a ditch $1\frac{1}{2}$ ft. wide, 2 ft. deep, and 300 ft. long is dug across a field. How many cubic feet of earth was it necessary to excavate? How many cubic yards?

8. How many cubic yards must be excavated in digging a ditch 2 ft. wide, 6 ft. deep, and 100 ft. long?

9. In building a house, 8100 cubic feet of earth were excavated for the basement. How many cubic yards were excavated?

*10. How many cubic yards of earth is it necessary to excavate in digging a basement 30 ft. wide, 60 ft. long, and 6 ft. deep? Find the cost of the excavation at 50¢ a cubic yard.

62. Computing Time

I. Finding a Difference in Hours and Minutes

[Use pencil only when needed.]

1. When the walk to school in the morning takes from 25 minutes past eight o'clock until 10 minutes before nine o'clock, how many minutes are spent?

2. The preparation of a history lesson in an evening takes from 15 minutes after seven o'clock until 10 minutes before eight o'clock. Find the time required.

Find the difference in time between:

3. 8:07 A.M. and 8:43 A.M.
4. 9:45 A.M. and 10:17 A.M.
5. 1:38 A.M. and 2:12 A.M.
6. 3:15 P.M. and 6:45 P.M.
7. 2:45 P.M. and 8:15 P.M.
8. 4:42 P.M. and 9:12 P.M.

9. How long a time is there between 11 o'clock in the morning and 15 minutes past 2 o'clock in the afternoon?

Find the difference in time between:

10. 10:00 A.M. and 3:45 P.M.
11. 11:30 A.M. and 4:00 P.M.
12. 8:30 A.M. and 2:30 P.M.
13. 6:30 A.M. and 2:10 P.M.
14. 9:15 A.M. and 4:00 P.M.
15. 10:15 A.M. and 3:30 P.M.

16. How many hours of daylight are there before noon when the sun rises at 6 o'clock? When it rises at 6:30? When it rises at 7:15?

17. What is the length of a winter's day when the sun rises at 7:30 A.M. and sets at 4:10 P.M.?

18. Find the length (1) of the shortest day in the year in the northern states, when the sun rises at 7:27 A.M. and sets at 4:30 P.M.; (2) of the longest day in the same states, when the sun rises at 4:22 A.M. and sets at 7:39 P.M.

19. What is the difference in the length of Christmas Day in St.

Paul and in New Orleans if in St. Paul the sun rises at 7:28 A.M. and sets at 4:31 P.M., and in New Orleans it rises at 7:01 A.M. and sets at 5:02 P.M.?

20. Find the difference in the length of the day on the Fourth of July in Boston and in Charleston, when in Boston the sun rises at 4:27 and sets at 7:39, and in Charleston it rises at 4:56 and sets at 7:11.

21. With the help of the table below, make and solve other problems showing the difference in the lengths of the days:

	LATITUDE OF NEW YORK		LATITUDE OF BOSTON		LATITUDE OF WASHINGTON		LATITUDE OF CHARLESTON	
	Sun Rises	Sun Sets	Sun Rises	Sun Sets	Sun Rises	Sun Sets	Sun Rises	Sun Sets
June 22	4:29	7:34	4:22	7:40	4:34	7:28	4:53	7:11
Sept. 22	5:47	5:58	5:47	5:58	5:49	5:57	5:48	5:57
Dec. 22	7:21	4:35	7:27	4:30	7:16	4:41	7:00	4:59
Mar. 22	6:01	6:15	5:59	6:14	6:00	6:14	6:02	6:12

22. A man works in the morning from 7:59 till 12:00, and in the afternoon from 12:57 to 5:32. This is approximately how many hours?

II. Railway Time Schedules

[Use pencil only when needed.]

1. A train leaves one town at 7:15 A.M. and reaches the next place at 8:30 A.M. How long a time is taken for the run?

2. Find the time of the run made by each of the following trains:

	Train No. 113	Train No. 105	Train No. 153
Leave Chicago	9:00 A.M.	11:30 A.M.	2:45 P.M.
Arrive in Milwaukee	11:00 A.M.	1:40 P.M.	4:50 P.M.

3. Which of the three trains between Chicago and Milwaukee makes the best time? How much less time does this train require than each of the other trains?

4. In the time table given below, train No. 505 leaves New York at 7:50 A.M. and reaches Philadelphia at 10:13 A.M. At what time does it reach Washington?

	No. 505	No. 507	No. 507	No. 507	No. 509	No. 511	No. 515
(*Central Railroad of New Jersey*)	A M	A M	A M	P M	P M	P M	P M
Lve. New York. . . (*West 23d Street*)	7 50	9 50	11 50	1 50	3 50	5 50	11 50
" New York . . (*Foot Liberty St.*)	8 00	10 00	12 00	2 00	4 00	6 00	1 30
" Jersey City . . (*C. R.R. of N.J.*)	8 11	10 12	12 11	2 11	4 11	6 12	1 41
" Newark, N.J. . . . . "	7 55	9 50	11 35	1 16	3 35	5 38	- -
" Elizabeth . . . . . "	8 29	10 30	12 28	2 27	4 28	6 28	- -
" Plainfield . . . . . "	8 45	10 43	12 42	2 45	- -	6 44	- -
" Bound Brook . . . (*P. & R. Ry.*)	8 53	10 54	12 51	2 56	- -	6 56	2 27
" Trenton . . . . . "	9 15	- -	1 12	- -	- -	7 15	1 55
" Jenkintown . . . . . "	- -	- -	- -	- -	-	8 01	- -
" Wayne Junction . . . . "	9 58	12 08	1 59	3 58	5 53	8 11	3 47
Arr. Phila. 24th and Chestnut Streets	10 13	12 23	2 13	4 13	6 08	8 28	4 05
Lve. Phila. 24th and Chestnut Streets	10 17	12 30	2 17	4 18	6 12	8 31	4 15
" Chester . . . . (*B. & O. R.R.*)	10 35	12 50	2 35	- -	- -	8 49	4 35
" Wilmington . . . . . "	10 51	1 09	2 51	4 47	6 44	9 08	4 55
" Newark, Del . . . . . "	- -	1 28	- -	- -	- -	9 27	5 19
" Singerly . . . . . "	- -	- -	- -	- -	- -	- -	- -
Arr. Baltimore . . (*Mt. Royal Station*)	12 16	2 43	4 16	5 06	8 06	10 45	6 45
" Baltimore . . . (*Camden Station*)	12 20	2 47	4 20	5 13	8 13	10 50	6 50
Lve. Baltimore . . . . . "	12 25	3 00	4 25	5 16	8 16	10 55	7 00
Arr. Washington . . . (*Union Station*)	1 15	3 55	5 20	7 00	9 00	11 50	7 50

5. Read, for train No. 501, the time of leaving New York, the time of reaching Philadelphia, and the time of reaching Washington.

6. Read the same facts for each of the other trains.

7. How long does it take train No. 507 to make the trip from New York to Washington? How long does it take train No. 509? Which is the faster train?

8. Compare the running time of two other trains.

9. With the help of a local time table, make and solve problems on the time required to reach neighboring towns and cities.

Find the time required for each train in the following schedule:

10. Lve. New York 4 P.M. Arr. Boston 9:35 P.M.

11. " New York 9:30 A.M. " Philadelphia 11:46 A.M.

12. " New York 11:08 A.M. " Washington 4:20 P.M.

13.	Lve.	Chicago 6:35 P.M. Mon.	Arr.	St. Paul 7:20 A.M. Tues.
14.	"	Chicago 1:00 P.M. Thurs.	"	Omaha 11:45 P.M. Fri.
15.	"	Chicago 10:00 A.M. Tues.	"	New Orleans 8:30 P.M. Wed.
16.	"	St. Louis 8:20 P.M. Tues.	"	New Orleans 8:36 P.M. Wed.
17.	"	St. Louis 11:30 P.M. Wed.	"	Kansas City 7:45 A.M. Thurs.
18.	"	St. Louis 9:35 A.M. Thurs.	"	Houston (Tex.) 6:50 P.M. Fri.
19.	"	Spokane 7:25 A.M.	"	Tacoma 10:10 P.M.
20.	"	Spokane 8:25 A.M.	"	Portland 7:45 P.M.

*21. Clocks set by Central time are 1 hour behind those set by Eastern time. Find the time required for a journey on a train leaving New York at 5 P.M. Eastern time and reaching Detroit the following morning at 7:15 Central time.

*22. Clocks set by Pacific time are 2 hours behind those set by Central time. How many hours are required by a train leaving St. Louis Monday at 11:30 P.M. Central time to reach Los Angeles, if it arrives there on Friday at 1:10 P.M. Pacific time?

III. Record Voyages

[With pencil.]

1. What is the difference in the length of time taken to cross the Atlantic by a steamer making the trip in 6 days 20 hours 45 minutes, and by a steamer crossing in 4 days 18 hours 30 minutes?

6 da. 20 hr. 45 min. − 4 da. 18 hr. 30 min. = ?

6 da.	20 hr.	45 min.	
4 "	18 "	30 "	
2 da.	2 hr.	15 min.	

Find the difference in time:

2. Between a record of 7 days 18 hours 30 minutes and one of 5 days 12 hours 20 minutes.

3. Between a record of 6 days 20 hours 40 minutes and one of 6 days 8 hours 15 minutes.

A steamship holding a record for crossing the Atlantic in 4 days 18 hours 40 minutes broke her own record by crossing in 4 days 11 hours 42 minutes. What was the difference in the time required for the two trips?

4 da. 18 hr. 40 min. − 4 da. 11 hr. 42 min. = ?

4 da. 18 hr. 40 min.	Since 42 min. cannot be subtracted from 40 min., 1 hr. is taken from the 18 hr. and called 60 min.
4 „ 11 „ 42 „	40 min. + 60 min. = 100 min.
6 hr. 58 min.	100 min. − 42 min. = 58 min.
	17 hr. − 11 hr. = 6 hr.
	The difference was 6 hr. 58 min.

The following table gives the time taken by some of the famous record-breaking ships:

RECORD TRIPS ACROSS THE ATLANTIC

In 1869, the first 7-day boat, the City of Brussels, crossed in 7 days 22 hours.

In 1882, the first 6-day boat, the Alaska, crossed in 6 days 18 hours 37 minutes.

In 1889, the first 5-day boat, the City of Paris, crossed in 5 days 19 hours 18 minutes.

In 1907, the first 4-day boat, the Lusitania crossed in 4 days 18 hours 40 minutes.

4. The Alaska took how much less time to cross the Atlantic than the City of Brussels?

5. Each of the later record breakers took how much less time than the one that preceded it?

6. Make and solve two other problems in finding the difference in time taken by these ocean liners.

7. In airship travel an early record for duration for an aviator alone was 11 hr. 1 min. 29 sec.; the record for an aviator with one passenger was 4 hr. 34 min. Find the difference.

IV. The Calendar

Months	Number of Days	Months	Number of Days
January	31	July	31
February	28 or 29	August	31
March	31	September	30
April	30	October	31
May	31	November	30
June	30	December	31

[Use pencil only when needed.]

1. Which four months contain thirty days? Memorize their names.

2. How many days are there from June 14th to July 4th?

From June 14th to July 1st, there are 30 da. − 14 da., or 16 da.
16 days in June + 4 days in July = — days.

3. When Thanksgiving comes on November 24th, how many days are there before Christmas?

4. How many days are there from the ninth of January to Washington's birthday? From May 15th to Flag Day, June 14th? From May 30th to July 4th?

Find the number of days from:

5. Jan. 4 to Feb. 1.
6. Jan. 8 to Feb. 12.
7. May 1 to June 14.
8. Apr. 30 to May 16.
9. July 4 to Sept. 1.
10. Oct. 30 to Dec. 25.

11. How many days are there from Feb. 22d to Mar. 15th in a common year? In a leap year?

12. A party entering Yellowstone Park July 23d left it on August 6th. How many days did they spend in the Park?

Find the number of days taken:

13. For a trip to Cuba, by a steamer leaving New York on the 26th of December and returning the 16th of the following month.

14. For a voyage to the Panama Canal by a boat leaving New Orleans Jan. 28th and reaching the canal Feb. 5th.

15. For a trip to Europe lasting from the 6th of June to the 10th of the following October.

16. For a journey around the world lasting from the 4th of March until the 8th of the following November.

17. The Pilgrim Fathers left Plymouth, England, the 6th of September, 1620, and anchored in Cape Cod bay on the 11th of November. How long did it take them to cross the Atlantic?

18. The Great Western, one of the first two steamships to cross the Atlantic, sailed from England, April 8th, 1838, and arrived in New York the 23d of the same month. How many days did it take to cross the Atlantic?

*19. A record trip around the world took from 1:15 P.M., July 17th, until 8:58 A.M., August 26th. Find the exact number of days, hours, and minutes taken.

V. Subtraction of Dates

The War of 1812 began on June 18, 1812, and ended February 17, 1815. How long did it last?

Since June is the sixth month of the year and February the second, the dates are written as follows:

1815 yr. 2 mo. 17 da.	Since 18 days cannot be subtracted from 17 days, 1 month is taken from the 2 months in the minuend, called 30 days, and added to the 17 days. 30 da. + 17 da. = 47 da.; 47 da. − 18 da. = 29 da.
1812 " 6 " 18 "	
2 yr. 7 mo. 29 da.	

Since 6 months cannot be subtracted from 1 month, 1 year is taken from 1815, is called 12 months, and is added to the 1 month. 12 mo. + 1 mo. = 13 mo.; 13 mo. − 6 mo. = 7 mo.

Subtracting 1812 years from 1814 years, the remainder found is 2 years. The war lasted 2 yr. 7 mo. 29 da.

The subtraction of dates gives a result accurate enough for most purposes. It is not, however, quite accurate, owing to the fact that the months are all counted as containing 30 days.

[With pencil.]

1. The War of the Revolution began April 19, 1775, and ended April 11, 1783. Find how long it lasted.

The following list gives the dates of the beginning and the completion of some of the greatest engineering feats in history. Find the time required for each:

GREAT ENGINEERING FEATS

2. The Erie Canal was begun July 4, 1817, and completed Nov. 4, 1825.

3. The Suez Canal was begun Apr. 25, 1859, and opened Nov. 17, 1869.

4. The Panama Canal was begun May 4, 1904 (by the United States), and opened for first shipping August 15, 1914.

5. Brooklyn Bridge, the first great bridge built to connect Brooklyn with New York city, was begun Jan. 3, 1870, and opened for use May 24, 1883.

6. The first long tunnel (8 miles long) built in the Alps was begun Aug. 31, 1857, and completed Sept. 17, 1871.

*7. Work was begun on the two ends of the second great tunnel through the Alps in September, 1872. The last bit of earth was cut away in February, 1880, so that the two heads of the tunnel met. The entire distance cut was 9 miles 564 yards. What was the average number of yards cut per year?

CHAPTER VIII. REVIEW

63. Working at a Trade

[Use pencil only when needed.]

1. The following list gives the names of workers in some of the leading trades. From the list, select (1) the men who are needed when a person is building or repairing a house; (2) those engaged in making clothing; and (3) those employed in making books:

carpenter	spinner	tailor
mason	weaver	shoemaker
printer	bookbinder	paperhanger
milliner	dressmaker	dyer
painter	electrician	gardener
tinsmith	glazier	cabinet maker

The wages of men working at a trade are usually computed either by the day or by the hour.

2. What is the length of a working day lasting from 7:30 in the morning until 12 o'clock at noon, and from 1 o'clock to 4:30 in the afternoon?

3. What are the wages per hour received by a man working 8 hours for $3.50?

Find what pay is received per hour by a man:

4. Working 8 hours a day for $4.00.

5. Working 8 hours a day for $4.80.

6. Working 8 hours a day for $7.20.

7. Working 8 hours a day for $6.00.

8. Working 9 hours a day for $4.50.

Find how much should be paid:

9. To a paperhanger for $7\frac{1}{2}$ hours of work at 60¢ an hour.

10. To an electrician for $8\frac{3}{4}$ hours of work at $1.00 an hour.

11. To a plumber for $2\frac{1}{2}$ hours of work at 90¢ an hour.

12. To a window cleaner for working from 8 o'clock till 11:30 in a morning at 50¢ an hour.

13. To a carpenter for working from 7:30 A.M. till 12 M. and from 1:30 P.M. till 5:30 P.M. at 90¢ an hour.

Find the amount due each of the following men working on an 8-hour-a-day schedule:

14. A carpenter working 6 hours at $7.20 a day.

15. A painter working $7\frac{1}{2}$ hours at $6.40 a day.

16. A hod carrier working 7 hours at $4.80 a day.

17. A plasterer working $6\frac{1}{4}$ hours at $7.20 a day.

18. A plumber working $5\frac{1}{2}$ hours at $8.00 a day.

19. A shoe cutter working $7\frac{1}{2}$ hours at $7.00 a day.

20. A workman receives 80¢ an hour for working 8 hours a day, and double pay for over-time. At this rate, how much should he receive for a day's work including $1\frac{1}{2}$ hours over-time?

*21. Make a list of wages in your community for five different trades. Use this list for problems of your own.

64. The Time Clock

[Without pencil.]

In many factories and large stores, employees register on a time clock their time of reaching and their time of leaving their place of work. The record printed within the clock is taken by the bookkeeper, and the wages due the employees are computed from it. The time is computed to the nearest quarter of an hour. 8 hours 5 minutes is counted as 8 hours; 8 hours 35 minutes, as 8½ hours.

Compute the wages due:

1. For 6 hours 20 minutes of work at 40¢ an hour.

2. For 7 hours 25 minutes of work at 60¢ an hour.

3. For 5 hours 40 minutes of work at 80¢ an hour.

4. For 8 hours 55 minutes of work at 90¢ an hour.

5. A time card registers: In 8:00. Out 12:01. In 12:58. Out 5:03. How many hours long was the working day?

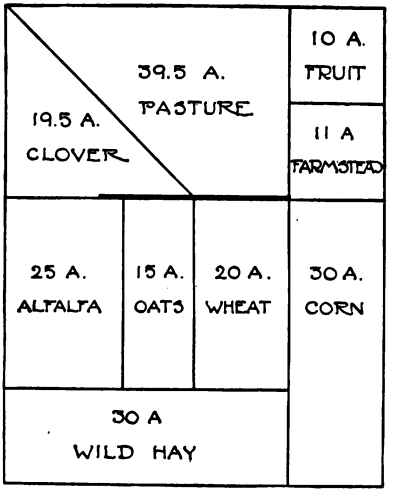
6. Mr. Brown works in a factory 9 hours a day for $7.20. His time card for a certain day showed that he was five minutes late in the morning. For this he loses a quarter hour's pay. How much was due him for the day?

65. Running a Farm

I

[Use pencil only when needed.]

1. The land in the farm shown in the drawing is valued at $150 an acre; the stock, buildings, machinery, and tools on the farm are valued at $15,000. What is the total value of the farm?



2. Name the kinds of grain and kinds of hay raised on the farm and the number of acres used for each.

3. In planting the wheatfields, 90 lb. of grain are allowed for each acre. At this rate how many bushels are required for 20 acres? (1 bu. of wheat weighs 60 lb.)

4. For the cornfields, 8 lb. of seed are allowed to the acre. At $3.00 a bushel, how much does the seed for 30 acres cost? (1 bu. of shelled corn = 56 lb.)

5. The wheatfields gave in a recent year a yield of 22.2 bu. to the acre. At $2.25 a bushel, what was the value of the wheat crop?

6. The cornfields yielded 39.9 bu. to the acre, and the corn sold at $1.50 a bushel. Find the value of the corn crop.

7. The fields planted with oats yielded 35 bu. to the acre. Find the value of the oats at $.90 a bushel.

8. The cost of raising the wheat averaged $1.48 a bushel; of raising the corn, $.65 a bushel; of raising the oats, $.56 a bushel. Find the total cost of raising these crops.

9. What was the profit on the three grain crops?

10. The fields from which wild hay was harvested yielded 1.25 tons to an acre; the clover fields, 2.04 tons to the acre; the alfalfa fields, 3.33 tons. Find the value of these crops when wild hay sells for $24.00 a ton; clover, for $30.00 a ton; and alfalfa, for $28.00 a ton.

*11. The cost of raising and harvesting the wild hay was $9.37 a ton; the cost of the clover was $12.36 a ton; the cost of the alfalfa, $14.26 a ton. Find the profit on these crops.

*12. The profit from all other farm produce, such as cattle, poultry, and fruit was $1951.08 for the year. What was the total profit per acre for the entire farm?

II

[Use pencil only when needed.]

1. A field is 16 rods wide and 20 rods long. How many square rods does it contain. How many acres?

2. How many acres are there in a field 15 rods wide and 32 rods long? In one 42 rods wide and 72 rods long?

3. From a pasture 40 rods wide and 60 rods long, $1\frac{1}{2}$ acres are fenced off. How many acres are left in the pasture?

4. The cornfield pictured on page 263 contains 30 acres. What is its area in square rods?

5. The cornfield is 40 rods wide. What is its length in rods? In feet?

6. The wheatfield contains 20 acres and is 80 rods in length. What is its perimeter in rods? In feet?

III

[With pencil.]

1. A city family moved to the country and purchased a farm valued at $27,500. In five years' time the farm increased in value 20%. At how much was it then valued?

2. The table below shows the farm receipts and expenditures during the five years. Find the net income for each year by subtracting the total expenditures from the total receipts for that year.

RECEIPTS	1st year	2d year	3d year	4th year	5th year
Cattle, including fat cattle sold . . .	$1,381.87	$2,684.39	$200.00	$500.00	$700.00
Sheep, lambs, wool .	400.00	400.00	500.00	550.00	750.00
Wheat	1,480.30	1,230.00	751.00	1,557.00	1,682.00
Corn	765.00	969.50	600.00	1,000.00	900.00
Oats	112.00	–	–	–	75.00
Hay	490.00	–	700.00	800.00	960.00
Pork products . . .	72.00	–	–	–	–
Live hogs	50.00	135.00	300.00	200.00	750.00
Poultry, dairy, and garden products . .	350.00	375.00	400.00	400.00	600.00
Wood	180.00	–	–	–	–
Apples	–	500.00	–	1,427.00	1,680.00
Total receipts .					
EXPENDITURES					
Labor	$500.00	$400.00	$450.00	$500.00	$700.00
Taxes	170.00	150.00	138.00	145.00	168.00
Farm supplies . . .	250.00	300.00	300.00	300.00	400.00
Interest on debt . .	360.00	360.00	360.00	344.00	240.00
Fertilizer	150.00	135.00	116.50	147.86	185.39
Seed	211.00	212.00	150.00	150.00	188.00
Grain and hay for stock (produced on farm and fed)	500.00	550.00	400.00	600.00	600.00
Cattle bought for feeding	650.00	1,763.00	–	–	–
Hogs for feeding . .	–	36.00	–	–	–
Extra labor picking apples, etc.	–	–	–	300.00	418.00
Total expenditure					
Net income					

*3. The net income was how much greater the fifth year than the first?

*4. This increase was what per cent of the net income for the first year?

66. The Money Value of an Education [1]

[With pencil.]

1. Two boys of the same ability went to school together. One stopped school when he was 14 years old and went to work; the other graduated from a trade high school at 18, and then he also went to work. The record of these two boys showed that at 30 years of age the boy who stopped school when he was 14 was earning $30.40 a week, and the boy who graduated from the trade high school was earning $56.00 a week. The difference in their wages amounted to how much per month (4 weeks)? Per year (52 weeks)?

2. The total earnings for the sixteen years covered between the ages of 14 and 30 amounted to $10,321 for the first boy; and to $15,925 for the second boy. Find the average earnings for each boy per year for the 16 years.

3. A third boy went to college, so that he was 22 years old before he could go to work. By the time he was 30 years of age he was earning $65 a week. This was how much more than the boy who stopped school when he was 14 years of age? Than the boy who stopped when he was 18 years of age?

4. The college man's total earnings for 16 years (8 in school and 8 at work) amounted to $21,128. What were his average earnings per year for the sixteen years?

5. Copy and then complete this table:

	Earnings per year at 30	Average yearly earnings between 14 and 30
Man beginning Work at 14		
The High School Graduate		
The College Graduate		

[1] From a record made by a manufacturer who for many years employed men of different grades of education.

6. With the help of the table, make and solve three problems comparing the earnings of the three men.

67. Progress Score

With the help of these exercises measure your work in computing for the year. Try to make 100 points on each exercise, or a total of 500 points. Count for each correct answer the score given in parenthesis near the letter of the problem.[1]

I. Addition

Add: [Copy numbers only when necessary.]

A. (3) $4.98, 6.87, 5.36

B. (3) 2.78, 3.964, .79

C. (4) .976, .38, .494

D. (6) 475, 388, 464, 375, 473, 208, 390, 427, 879

E. (5) 5, 6, 7, 0, 4, 9, 8, 7, 6, 9, 8, 6, 6, 9

F. (10) 114, 19, 327, 18, 29, 78, 16, 17, 16, 29, 16, 19, 17, 28

G. (3) $\frac{5}{12}$, $\frac{1}{12}$

H. (3) $\frac{7}{8}$, $\frac{5}{8}$

I. (4) $12\frac{3}{4}$, $8\frac{3}{4}$

J. (5) $18\frac{5}{6}$, $7\frac{5}{6}$

K. (5) $8\frac{5}{12}$, $7\frac{1}{3}$

L. (6) $9\frac{3}{4}$, $8\frac{4}{5}$

M. (6) $17\frac{5}{6}$, $9\frac{8}{9}$

N. (6) $15\frac{5}{6}$, $8\frac{11}{12}$

O. (7) $21\frac{1}{3} + 8\frac{3}{4} + 6\frac{1}{6} = ?$

P. (7) $\$1.04 + 7\frac{1}{2}¢ + \$1.12\frac{1}{2} + \$3 = ?$

Q. (5) $7.43 + 84.5 + 6.125 = ?$

R. (12) $4.11 + .03\frac{1}{2} + 2\frac{3}{4} = ?$

II. Subtraction

Subtract: [Copy numbers only when necessary.]

A. (4) $6.25, 3.48

B. (5) 15.74, 8.9

C. (5) 99364, 2870

D. (6) 8000, 1327

E. (7) 403020, 76714

[1] To compare your standing in computing at midyear with your record above find the differences in the average of the two scores.

F. $22\frac{11}{12}$ (5) $\underline{9\frac{5}{12}}$ G. $44\frac{2}{3}$ (6) $\underline{16\frac{4}{15}}$ H. $33\frac{5}{8}$ (7) $\underline{18\frac{3}{8}}$ I. $27\frac{8}{10}$ (8) $\underline{19\frac{1}{6}}$ J. 75 (7) $\underline{16\frac{2}{3}}$

K. $46\frac{1}{5}$ (10) $\underline{27\frac{3}{5}}$ L. $38\frac{1}{4}$ (10) $\underline{14\frac{5}{8}}$ M. 68.3 − 9.16 = ? (8) N. $24.18 - 8\frac{3}{4} = ?$ (12)

III. Multiplication

Multiply:

[Copy numbers only when necessary.]

A. 9607 (3) $\underline{8}$ B. 980 (4) $\underline{76}$ C. 436 (4) $\underline{209}$ D. $3.15 (5) $\underline{240}$

E. $\frac{5}{8} \times 160 = ?$ (3) F. $\frac{2}{3} \times 14 = ?$ (4) G. $32 \times \frac{4}{5} = ?$ (5)

H. $\frac{2}{3} \times \frac{3}{4} = ?$ (5) I. $5\frac{1}{4} \times \frac{5}{6} = ?$ (7) J. $5\frac{1}{3} \times 2\frac{1}{3} = ?$ (8)

K. $41\frac{3}{4}$ (5) $\underline{8}$ L. $21\frac{1}{5}$ (6) $\underline{7}$ M. 24 (8) $\underline{2\frac{3}{8}}$ N. 16 (8) $\underline{3\frac{1}{5}}$ O. 4.12 (4) $\underline{6}$

P. 325 (4) $\underline{.07}$ Q. .078 (7) $\underline{1.2}$ R. $\$14.75 \times .7\frac{3}{8} = ?$ (10)

IV. Division

Do work indicated:

[Copy numbers only when necessary.]

A. $4\overline{|\$375.45}$ (5) B. $71\overline{|64326}$ (5) C. $49\overline{|38220}$ (6)

D. $9 \div \frac{2}{3}$. (5) E. $\frac{5}{12} \div \frac{5}{6}$. (5) F. $\frac{3}{4} \div 5$. (5) G. $3\frac{3}{4} \div 3\frac{1}{8}$. (10)

H. $75\overline{|234.16}$ (9) I. $164\overline{|11234}$ (10) J. $4000\overline{|\$284}$ (10)

K. $.04\overline{|78.48}$ (8) L. $.25\overline{|575}$ (10) M. $6.84 \div .2\frac{1}{4} = ?$ (12)

V. Using Per Cents

Copy and complete, counting 10 for each correct answer.

A. 3% of 540 = —.

B. $66\frac{2}{3}$% of 936 = —.

C. 750 increased 6% = —.

D. 860 increased 25% = —.

E. 875 decreased 4% = —.

F. 2400 decreased $37\frac{1}{2}$% = —.

G. 140 = —% of 560.

H. 25 = —% of 410.

I. 210 = 3% of —.

J. 6300 = $87\frac{1}{2}$% of —.

68. Problem Test[1]

I

Reduce: [Without pencil.]

1. $1\frac{1}{2}$ ft. to inches.
2. $\frac{3}{4}$ yd. to inches.
3. $1\frac{1}{3}$ yd. to inches.
4. 12 yd. to feet.
5. $8\frac{1}{2}$ yd. to feet.
6. 2 rd. to feet.
7. $\frac{1}{2}$ sq. yd. to square feet.
8. 36 in. to feet.
9. 40 in. to feet.
10. 18 in. to yards.
11. 45 in. to yards.
12. 54 in. to yards.
13. $\frac{1}{4}$ hr. to minutes.
14. $1\frac{1}{4}$ hrs. to minutes.
15. 20 min. to hours.
16. 40 min. to hours.
17. 90 min. to hours.
18. 36 hours to days.
19. $2\frac{1}{2}$ gal. to quarts.
20. 30 qt. to gallons.
21. 4.5 bu. to pecks.
22. $1\frac{1}{4}$ pk. to quarts.
23. $1\frac{1}{4}$ bu. to quarts.
24. 40 pks. to bushels.

II

[Use pencil only when needed.]

1. Find the sum in inches of 1 foot and $\frac{1}{2}$ yd.

[1] See footnotes, pages 88 and 137.

2. A picture $3\frac{1}{4}''$ by $4\frac{1}{4}''$ is to be mounted on a cardboard with a margin on each side of $1\frac{1}{2}''$. What are the dimensions of the cardboard required?

3. Two boards are nailed side by side. One is $7\frac{3}{4}''$ wide; the other, $6\frac{3}{4}''$ wide. What is their combined width?

4. A line 6 in. long can be divided into how many lengths each $1\frac{1}{2}$ in. long?

5. From 8 yd. of cloth, two pieces are cut. One piece is $2\frac{3}{4}$ yd. long; the other, $3\frac{1}{8}$ yd. long. Find the length of the piece left.

6. A box measuring on the inside 4 in. in depth, 6 in. in width, and 8 in. in length, contains how many cubic inches?

7. A blackboard 5 ft. high and 12 ft. long contains how many square yards?

8. A triangular flower bed measures 9 ft. 8 in. on a side. How many feet of wire netting are required to enclose it?

9. A lawn containing 800 sq. ft. is 40 ft. in length. What is its width?

10. A plot of ground in the shape of a square contains 144 sq. ft. What is its perimeter?

11. How many minutes are there in the morning between 8:25 and 9:15?

12. A train leaving New York at 11:30 A.M. and reaching Washington at 5:10 P.M. takes how many hours and minutes for its run?

13. A newsboy buys papers at the rate of 3 for 4¢ and sells them at 2¢ apiece. Find his profit on 20 papers.

14. A boy working for 10¢ an hour should receive how much pay for working 6 afternoons from 4:30 until 6 o'clock?

15. In a school of 40 members, 5 pupils are absent. What is the per cent of absence? Of attendance?

[With pencil.]

16. The monthly charge for a telephone is $2.10; the average monthly expense for toll calls, 40¢. Find the cost per year.

17. A gas bill for $2.70 is to be paid before the tenth of the month at a discount of 10%. What sum should be paid?

18. A coal bill for $3\frac{1}{2}$ tons of coal @ $12.25 a ton and 4 tons @ $10.75 is due, with an extra charge of 25¢ a ton for delivering in baskets. What is the total bill?

19. Find the amount due on the following laundry bill: 4 shirts @ $12\frac{1}{2}$¢, 6 collars @ $2\frac{1}{2}$¢, 3 pairs of cuffs @ 5¢ a pair, 8 handkerchiefs at the rate of 2 for 5¢, and 3 pairs of socks @ 5¢ a pair.

20. Muslin is to be bought for 12 new curtains, each requiring $2\frac{7}{8}$ yards. How much will the muslin cost at 40¢ a yard?

21. A family spends $550 a year for food. This is $33\frac{1}{3}$% of their income. Find their income.

22. Find the sum that balances the following household account: amount on hand at the beginning of the month, $8.22; the sums received during the month, $2.75, $24.25, $12.64, and $18.00; the sums paid out, $1.84, $24.35, $16.75, and $1.45.

23. Find the average monthly cost of groceries for a family of four, with the monthly bills as follows: Jan., $37.32; Feb., $29.64; Mar., $30.18; Apr., $27.33; May, $26.46; June, $28.96; July, $25.14; Aug., $24.19; Sept., $27.65; Oct., $28.22; Nov., $30.27; Dec., $34.63.

24. On Sept. 20, 1519, Magellan's fleet started on its trip around the world. On Sept. 6, 1522, the part of the fleet that had not been destroyed returned. How long a time was taken by this, the first circumnavigation of the globe?

25. There are three types of problems in percentage: (1) Finding a given per cent of a number; (2) finding a number when a per cent of it is given; (3) finding what per cent one number is of another. Make and solve one of each of these three types of problems.

Supplementary Practice for Speed and Accuracy

Add:

A. Time allowance, from $3\frac{1}{2}$ to $4\frac{1}{2}$ minutes for 5 problems.

1. 3794	2. 2132	3. 1322	4. 2132	5. 4685
1031	4204	2000	7966	2131
6857	3224	5455	5488	7946
2132	8979	4956	8565	8899
7946	8587	8988	8957	6858
6. 7845	7. 2113	8. 2324	9. 8200	10. 4273
4921	8997	9279	6799	4312
7780	5768	1632	1543	9768
9444	9885	4897	2367	6879
8867	2438	6887	4798	7889

B. Time allowance, from $3\frac{1}{2}$ to $4\frac{3}{4}$ minutes for 5 problems.

11. 6785	12. 87362	13. 56125	14. 5347	15. 8324
4321	17654	4324	14464	7981
14654	5784	31752	8792	3840
3924	4692	7648	9264	27952
54267	86885	324	14875	84636

C. Time allowance, from $1\frac{1}{4}$ to $1\frac{1}{2}$ minutes for 3 problems.

16. 7	17. 4	18. 8	19. 6	20. 4	21. 5	22. 7	23. 2	24. 9
2	5	3	2	4	2	4	9	4
3	4	2	4	6	6	5	7	5
4	6	8	5	7	8	3	7	8
5	4	6	6	4	9	7	6	4
6	3	6	7	3	0	9	9	9
7	2	4	3	4	7	3	4	5
8	5	3	2	2	8	8	9	7
9	6	8	9	7	8	0	3	8
4	6	7	2	6	6	6	6	9
3	9	8	3	9	8	5	8	0
2	7	5	9	9	7	8	7	8

D. Time allowance, from 4 to 5 minutes for 5 problems.

[With pencil.]

25. 434	26. 257	27. 104	28. 632	29. 281
345	456	567	456	567
324	654	765	357	820
434	345	657	566	508
245	665	566	755	385
444	456	767	376	258
235	565	456	367	478
656	843	459	245	956
255	568	567	104	858

Subtract:

E. Time allowance, $1\frac{3}{4}$ to $2\frac{1}{2}$ minutes for 10 problems.

30. 7346	31. 12468	32. 8768	33. 13567	34. 5437
3682	5370	2973	7890	3198
35. 24755	36. 6392	37. 34639	38. 9437	39. 53674
8490	1847	7870	1982	8390

F. Time allowance, $1\frac{3}{4}$ to $2\frac{3}{4}$ minutes for 10 problems.

40. 6400	41. 5090	42. 5000	43. 4000	44. 8000
2103	1907	1232	1738	1376
45. 7003	46. 4500	47. 7000	48. 8070	49. 9000
3298	3892	1432	7790	2736

G. Time allowance, $1\frac{3}{4}$ to $2\frac{3}{4}$ minutes for 10 problems.

50. 58341	51. 89350	52. 62245	53. 48037	54. 76203
5276	4271	3176	7960	3108
55. 97065	56. 32047	57. 57640	58. 94306	59. 83075
2070	9238	3587	8499	9968

Before timing yourself on one of these exercises, copy the problems in it in form for work.

H. $\frac{3}{4}$ to 1 min.

1. 1382 × 6.
2. 4087 × 5.
3. 7436 × 9.
4. 5768 × 7.

I. $\frac{3}{4}$ to 1 min.

5. 965 × 80.
6. 587 × 90.
7. 763 × 400.
8. 698 × 700.

J. 3 to $4\frac{1}{4}$ min.

9. 638 × 53.
10. 487 × 46.
11. 987 × 28.
12. 398 × 68.

J. $2\frac{3}{4}$ to 4 min.

13. 780 × 69.
14. 960 × 78.
15. 405 × 93.
16. 804 × 86.

K. 3 to $4\frac{1}{4}$ min.

17. 429 × 204.
18. 728 × 306.
19. 647 × 507
20. 741 × 409.

K. $3\frac{1}{4}$ to $4\frac{1}{4}$ min.

21. 639 × 208.
22. 376 × 405.
23. 589 × 607.
24. 298 × 809.

K. $2\frac{1}{2}$ to $3\frac{1}{2}$ min.

25. 4213 × 423.
26. 5644 × 218.

K. $2\frac{1}{2}$ to $3\frac{1}{2}$ min.

27. 7325 × 642.
28. 8376 × 780.

K. $2\frac{1}{2}$ to $3\frac{1}{2}$ min.

29. 3649 × 960.
30. 7356 × 587.

L. $1\frac{3}{4}$ to 3 min.

31. 28,552 ÷ 4.
32. 18,837 ÷ 3.
33. 29,617 ÷ 7.
34. 13,888 ÷ 8.
35. 52,353 ÷ 9.

L. $1\frac{3}{4}$ to 3 min.

36. 54,961 ÷ 6.
37. 29,963 ÷ 7.
38. 39,932 ÷ 5.
39. 57,885 ÷ 8.
40. 64,264 ÷ 9.

L. $1\frac{3}{4}$ to 3 min.

41. 283,920 ÷ 60.
42. 726,840 ÷ 40.
43. 569,250 ÷ 90.
44. 975,400 ÷ 200.
45. 998,800 ÷ 800.

M. $2\frac{1}{2}$ to 4 min.

46. 19,642 ÷ 61.
47. 29,232 ÷ 72.
48. 24,705 ÷ 81.
49. 49,680 ÷ 54.
50. 40,176 ÷ 93.

M. $2\frac{1}{2}$ to 4 min.

51. 26,649 ÷ 423.
52. 62,136 ÷ 863.
53. 44,362 ÷ 541.
54. 32,336 ÷ 752.
55. 61,194 ÷ 651.

N. 5 to 8 min.

56. 12,236 ÷ 38.
57. 30,221 ÷ 47.
58. 81,345 ÷ 87.
59. 51,884 ÷ 68.
60. 57,620 ÷ 67.

N. 5 to 8 min.

61. 16,422 ÷ 391.
62. 64,206 ÷ 783.
63. 36,672 ÷ 573.
64. 36,135 ÷ 495.
65. 57,154 ÷ 697.

O. 7 to 10 min.

66. 25,413 ÷ 43.
67. 30,680 ÷ 65.
68. 36,225 ÷ 75.
69. 373,680 ÷ 540.

O. 7 to 10 min.

70. 21,616 ÷ 56.
71. 76,538 ÷ 98.
72. 60,030 ÷ 69.
73. 26,063 ÷ 67.

O. 3½ to 5 min.

74. 12,246 ÷ 157.
75. 11,033 ÷ 187.

O. 3½ to 5 min.

76. 15,575 ÷ 175.
77. 11,692 ÷ 148.

O. 3½ to 5 min.

78. 11,055 ÷ 165.
79. 14,952 ÷ 178.

Tables used in Measurements

Linear Measure

12 inches (in.) = 1 foot (ft.).
3 feet = 1 yard (yd.).
5½ yards, or 16½ feet = 1 rod (rd.).
320 rods, or 5280 feet = 1 mile.

1.15 common miles = 1 nautical mile.

Square Measure

144 square inches (sq. in.) = 1 square foot (sq. ft.).
9 square feet = 1 square yard (sq. yd.).
30¼ square yards = 1 square rod (sq. rd.).
160 square rods = 1 acre (A.).
640 acres = 1 square mile (sq. mi.).

Cubic Measure

1728 cubic inches (cu. in.) = 1 cubic foot (cu. ft.).
27 cubic feet = 1 cubic yard (cu. yd.).

In measuring wood, 16 cubic feet are called a cord foot (cd. ft.); 128 cubic feet, a cord (cd.).

Liquid Measure

4 gills (gi.) = 1 pint (pt.).
2 pints = 1 quart (qt.).
4 quarts = 1 gallon (gal.).

Dry Measure

2 pints = 1 quart.
8 quarts = 1 peck (pk.).
4 pecks = 1 bushel (bu.).

Weight

16 ounces (oz.) = 1 pound (lb.).
100 pounds = 1 hundredweight (cwt.).
2000 pounds = 1 ton (T.).
2240 pounds = 1 long ton.

Number

12 units = 1 dozen (doz.).
12 dozen = 1 gross (gro.).
24 sheets of paper = 1 quire.
20 quires, or 480 sheets = 1 ream.

United States Money

10 cents (¢) = 1 dime.
10 dimes = 1 dollar ($).
100 cents = 1 dollar.
10 dollars = 1 eagle.
20 dollars = 1 double eagle.

Time

60 seconds (sec.) = 1 minute (min.).
60 minutes = 1 hour (hr.).
24 hours = 1 day (da.).
7 days = 1 week (wk.).
365 days = 1 common year (yr.).[1]
366 days = 1 leap year.

[1] Other equivalents for 1 year are: 52 weeks; 13 lunar months of 4 weeks each; 12 calendar months containing 30 or 31 days each (except February).

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